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HIGH ALTITUDE VEHICULAR EMISSION CONTROL PROGRAM

VOLUME V. DEVELOPMENT OF TECHNIQUES, CRITERIA, AND STANDARDS TO IMPLEMENT A VEHICLE INSPECTION, MAINTENANCE AND MODIFICATION PROGRAM

OLSON LABORATORIES, INCORPORATED

PREPARED FOR
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FINAL REPORT
VOLUME V

DEVELOPMENT OF TECHNIQUES, CRITERIA, AND STANDARDS TO IMPLEMENT A VEHICLE INSPECTION, MAINTENANCE AND MODIFICATION PROGRAM

Prepared under Contract Agreement
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REVIEW NOTICE

This report has been reviewed and approved for publication by the U. S. Environmental Protection Agency, the State of Colorado Air Pollution Control Commission and the Air Pollution Control Division. Approval does not signify that the contents necessarily reflect the views and policies of the EPA, APCC or APCD, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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Because this study was designed to update a previous report, it draws heavily from the "Vehicle Emission Inspection and Control Program" study prepared in November 1972 for the Health Department. In addition, much of the information on vehicle safety inspection was extracted from the "Motor Vehicle Safety Inspection Program Study" prepared in November 1972 for the Colorado Department of Revenue, Motor Vehicle Division. Both studies were prepared by Olson Laboratories under separate contract with the respective departments.

ABSTRACT

This volume of the final report evaluates the factors that would affect the integration of the proposed vehicle emission inspection program with the existing vehicle safety inspection program. The analysis considers only light-duty, passenger vehicles and excludes motorcycles, trucks, busses, and trailers which currently also are safety inspected.

Included in the reported results are federal and Colorado vehicle safety inspection procedures, estimated task times, and an approximate inspection fee. An estimate of vehicle Idle emission inspection also is provided in terms of task time and approximate fee. Cost estimates are provided for both state-operated and privately-operated stations performing both safety and emissions inspections. Based on expected investment and operating expenses, the inspection fees for annual and semi-annual testing are determined.

The results of three previously completed public opinion surveys are evaluated. Responses to questions relative to various transportation and emission control strategies are discussed. Results of this analysis are used to develop requirements for future surveys and public information programs. Vehicle owner considerations are discussed in terms of certified stations and inspectors, posted signs and labor rates, procedures for requesting waivers and filing consumer complaints, and other factors that promote consumer protection. Legislative considerations are included as they affect future programs involving vehicle retrofit and engine modifications.

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SECTION 1

CONCLUSIONS

1.1 VEHICLE EMISSION INSPECTION AND MODIFICATIONS

- Vehicle emissions inspection following Idle test procedures in privately-operated, licensed facilities, with two qualified inspectors and one HC/CO analyzer costing up to $2,500 per station, was estimated in 1972 to cost the vehicle owner approximately $5.45, which included $0.60 for State administrative costs.

- A reduction of inspector training requirements and initial capital equipment required to perform emission testing would lower the estimated emissions inspection fee at licensed stations to $4.00 per vehicle.

- The pilot program for Idle inspection, as described in Volume II, showed that the average inspection charges were $4.05 for inspections in privately operated stations.

- Vehicle owner maintenance to satisfy Idle emission limits would average $10.57 per serviced vehicle, as established in the pilot program. Previous studies have established the average costs to be on the order of $17 to $36 per vehicle.

- Emission reductions for Idle inspection coupled with emission-related maintenance was determined to be a function of limits established to reject a given proportion of inspected vehicles. Analysis and interpretation of data from Volume II indicate that emission limits set to fail about 50 percent of inspected vehicles would be near optimum in terms of reductions in HC, CO, and NO_x.

- With emission limits set to fail roughly half of the inspected vehicles, the overall emission reduction which considers both serviced and unserviced (passed) vehicles would be about 13 percent for HC, 8 percent for CO and 1 percent for NO_x.

- Idle emissions inspection at newly constructed, State-operated facilities would cost the vehicle owner approximately $2.10 for an annual inspection.

- Vehicle retrofit systems are effective in achieving further emission reductions. The more costly approaches such as catalytic converters and LPG fuel systems are most effective in reducing HC and CO emissions. Less costly approaches, including exhaust gas recirculation, vacuum spark advance disconnect, and air bleed to the induction system, are not as effective in achieving reductions of HC and CO. Combinations of these basic approaches also are available. The most cost-effective retrofit system evaluated and discussed in detail in Volume II was the air bleed with an exhaust gas recirculation (EGR) system, with an average installed cost of $25 per vehicle.

- Vehicle manufacturers' high altitude modification kits included replacement of various carburetor and distributor components and adjustment in ignition timing. In general, these modification kits, as described in detail in Volume II, were not effective in achieving reductions, and in some cases were found to increase emissions appreciably, notably NO_x. Average installed costs ranged from $4 to $14 per vehicle.

- Engine tuning specifications as modified for high altitude operation included modifications to the vacuum choke kick, basic ignition timing, idle air-fuel mixture and basic idle speed. As described in Volume II, these modifications taken individually or in combinations had degrading effects on NO_x emissions. However, HC and CO reductions on the order of 10 to 25 percent may be expected. No additional vehicle owner costs are anticipated because these modifications, if imposed, would become variations of an integral part of all vehicle tune-up specifications.

- Mandatory maintenance for all vehicles would involve the removal and replacement of spark plugs, distributor points and condenser, and carburetor air filter element. Adjustments would be made as necessary for proper distributor dwell angle, ignition timing, idle speed rpm, and carburetor idle air-fuel mixture. The expected average cost would range from $33 to $59 per vehicle, as determined in Volume II. Expected emissions reductions would be 19 percent for HC, 9 percent for CO, and 8 percent for NO_x.

1.2 VEHICLE SAFETY INSPECTION

- Vehicle safety inspection in accordance with the U. S. National Highway Traffic Safety Administration (NHTSA) requirements would require approximately ten minutes of inspection task time and would cost the vehicle owner $2.25 per inspection.

- Safety inspection in accordance with the Colorado Motor Vehicle Division requirements is more comprehensive, would not require additional inspection equipment than currently used, would involve approximately 13 minutes of task time, and would cost the vehicle owner $2.90 per inspection.

- Combined safety-emissions inspection at licensed stations has been estimated to require 22 minutes and cost the vehicle owner $5.73 per annual inspection, which includes $4.40 station cost plus $1.33 State cost. The owner cost for a semi-annual, combined inspection would be approximately $5.07 per inspection, with $4.40 for station cost plus $0.67 for State cost.

- For a combined inspection, roughly 4,200 privately-operated, licensed stations distributed throughout the State would be upgraded to include emission testing. For the State-operated alternative, 66 fixed sites and 23 mobile units would be required at an initial investment cost of $11 million and an annual operation cost of $9.8 million.

- A combined safety-emissions inspection at newly constructed State facilities would cost the vehicle owner $8.30 for an annual inspection and $4.15 for a semi-annual inspection.

- Semi-annual safety — emissions inspection is less costly than annual inspection at State-operated facilities because of increased utilization which approaches maximum design capability. Fixed costs are allocated over more vehicles inspected leading to a lower inspection fee.

- The licensed station inspection cost is comprised of a fixed State administrative annual cost allocated over the number of compliance stickers sold plus the apportioned station labor rate. Chargeable inspection time does not vary per visit; only the allocated State sticker cost varies. Consequently, there is little difference between annual and semi-annual cost.

1.3 PUBLIC OPINION SURVEYS

- A comparative analysis of three public opinion surveys conducted in Colorado during 1972 indicated the following sentiments regarding vehicle emissions inspection, maintenance and modification:
  - There is no majority agreement on what a reasonable emission inspection fee should be. However, a fee of $2.00 or less would receive the highest favorable response.
  - The residents are somewhat divided as to who should operate the emission inspection facilities, a governmental agency or privately-owned, licensed stations. On a statewide basis, there is a slight preference, less than a majority, for licensed stations. A majority of rural residents favor licensed stations.

  - The majority of residents favor twice-a-year emission inspections.

  - The majority of residents agree that emission control strategies should apply to all motorists regardless of residency and to all vehicles regardless of age.

  - The majority of residents would support an emission control program because they believe that the automobile is the greatest contributor to air pollution. However, the residents expressed a definite lack of knowledge about the existence of emission control devices on cars and the associated costs to have vehicles inspected and serviced for lower emissions.

  - With respect to program enforcement and penalties, the most frequent responses indicated a desire to keep vehicles off the roads until repaired, and to provide some form of government financial assistance to the financially handicapped. The more popular penalties suggested for emission control violations included monetary fines up to $50, an initial warning with a subsequent monetary fine, the suspension of a driver's license and the removal of vehicle license plates.

- In regard to the current vehicle safety program, the public opinion surveys showed that the overwhelming majority favor the concept, the twice-a-year inspecperiod, and the private garages performing the inspection. They are divided as to whether they would be willing to pay increased inspection fees to improve the program.

- In regard to other emission control strategies, the surveys showed that the majority would favor a mass transit system although they currently do not use the system. They are definitely opposed to gasoline rationing or toll ramps on major expressways. They would be receptive to staggered work hours and limited traffic and parking in central business districts. The residents would be somewhat receptive to car pooling, converting existing lanes of traffic to "bus or car pool" lanes. However, they are opposed to building more freeways or increasing traffic speed limits.

1.4 VEHICLE TAMPERING AND MODIFICATIONS

- With respect to the legality of modifying vehicles and engines to achieve lower emission levels, the federal EPA advisory circular on modifications for high altitude operation, in conjunction with its interim tampering enforcement policy, provides the State of Colorado with a sufficient basis of authority to impose vehicle retrofit devices and/or high altitude engine modifications. The Colorado Senate Bill 393 authorizes the Air Pollution Control Commission to adopt rules and regulations governing vehicle tune-ups, engine modifications and alterations.

- New car warranty requirements would not be voided if original-equipment-manufacturer parts are removed and replaced by after-market parts. The emission control system is warranted at the time of sale to be free from defects. After a vehicle and/or engine modification has been made to achieve lower emissions if a failure to comply with EPA regulations occurs, an assessment needs to be made to establish whether the fault was due to a defect existing at time of sale. Component failures related to or caused by the modifications will not be covered by the warranty.

SECTION 2

RECOMMENDATIONS

- Vehicle emission inspection coupled with emissions-oriented maintenance has been shown to be effective in achieving reductions. Because no conclusive relationships exist between emission levels and vehicle cumulative mileage and/or age at present, it is recommended that when emission inspection and maintenance become mandatory, annual emission inspections are imposed to minimize vehicle owner costs. This inspection interval may be modified subsequently based on results of studies currently in process. (see paragraphs 4.2 and 4.5.1)

- Air bleed to the induction system, and air bleed coupled with exhaust gas recirculation (EGR) have been shown to be feasible retrofit approaches to further emission reductions. The Colorado Air Pollution Control Commission and Division should establish definite procedures for approving these emissions-related vehicle modifications and/or retrofit devices and others so that present and future after-market manufacturers are cognizant of existing State requirements. (see paragraphs 4.3.1 and 6.4.1)

- Based on the pilot program data of Volume II and the analytical results of Volume III, the APCD and APCC should establish an implementation plan that considers both vehicle emission inspection and retrofit system installation (see paragraphs 4.2.2 and 4.3.2).

- The Departments of Health and Revenue should establish a data and information management system to capture inspection data and to analyze, interpret, and disseminate the information on program effectiveness for emissions reduction and vehicle safety. (see paragraphs 4.4, 4.5.2, and 5.3.1)

- A public information program should be established to inform the motorists initially of the inspection program objectives, inspected items and related maintenance costs, enforcement and penalties, and consumer protection plans. Periodically thereafter, the public should be advised of the inspection program effectiveness, failure trends, malpractice cases and dispositions, and other pertinent findings. (see paragraphs 4.5.2 and section 5)

- A public opinion survey should be conducted subsequently to assess the effectiveness of this public information and education program, to identify topic areas requiring further elucidation, and to evaluate control strategies not previously covered in surveys reviewed herein. (see para. 5.5)

- An opinion survey of business leaders, community leaders, academic institutions, special interest groups, legislators and others who are influential in creating, modifying or swaying public sentiment should be conducted. This survey would be to determine their sentiments on specific control strategies, identify other alternatives not considered, determine the effects of strategies on businesses and the environment, and define areas or questions requiring further analysis. (see paragraph 5.5.1)

- Consumer protection plans should consider the continuation and/or implementation of the following: (see section 6)

  (a) Licensed stations initially certified and periodically recertified four times a year on a quarterly basis.

(b) Certification of qualified safety and/or emissions inspectors.

(c) Posted "licensed station" signs for safety and/or emissions, displayed station and inspector certificates.

(d) Posted inspection fees and related labor rates for typical safety-related repairs and/or emission-related adjustments and servicing.

(e) Preparation and presentation of written repair cost estimates prior to any maintenance or servicing.

(f) Return to owner of original parts removed.

(g) Identification on repair invoice of all work performed, indication of rebuilt or remanufactured parts used, associated costs.

(h) Posted sign defining procedure for filing consumer complaint in cases of alleged malpractice.

(i) Posted sign defining procedure for filing waiver request in cases of undue hardship or disproportionate repair cost.

SECTION 3

INTRODUCTION

The automobile has long been recognized as a major contributor to air pollution. Studies have shown that the major pollutants emitted from an automobile are hydrocarbons, carbon monoxide, and oxides of nitrogen. Three primary sources of these pollutants are the engine crankcase emissions, exhaust emissions, and fuel evaporative emissions. Federal regulations were first imposed over a decade ago to limit crankcase emissions. Exhaust emissions were regulated initially in 1968, with more stringent limits imposed in succeeding years. Evaporative emissions were regulated beginning with the 1971 model automobile.

Recent studies conducted by federal and state agencies and also by independent laboratories have concluded that vehicles operating at high altitudes emit greater amounts of pollutants than similar vehicles operating at or near sea levels. Even vehicles that are well serviced and maintained exhibit this phenomenon. Various emission reduction and control strategies have been proffered and evaluated in the past. This volume of the high altitude emissions study addresses those factors that would facilitate implementing a program involving vehicle inspection, maintenance, and modification.

3.1 STUDY BACKGROUND

The 1972 Colorado Legislature, under House Joint Resolution Number 1012, directed the Department of Health to conduct a study for the Air Pollution Control Commission concerning the feasibility and problems of controlling motor vehicle emission through a statewide implementation of an inspection and control program. Many issues were cited in the resolution which the legislature desired to have investigated and evaluated prior to making any policy decision.

3.1.1 Emission Inspection Study

The Northrop Corporation, in association with its subsidiary Olson Laboratories, Inc., completed a study for the Health Department which was designed to evaluate the technical and economic feasibility and public acceptability of a mandatory and periodic vehicle inspection program. The study prepared for the Health Department was completed in November 1972 and was entitled "Vehicle Emission Inspection and Control Program." Results, conclusions, and recommendations from this previous study and others performed by the Air Pollution Control Division provided the bases for this subsequent study.

3.1.2 Safety Inspection Study

Also in November 1972, Olson Laboratories completed a study for the Department of Revenue, Motor Vehicle Division. The objective of that investigation was to analyze the existing vehicle safety inspection program, define areas for improvement, and develop an implementation plan. The Motor Vehicle Safety Inspection Program study submitted to the Revenue Department included recommendations concerning safety items tested, instrumentation, procedures and document format. Both of these studies touched on the subject of integrating safety and emissions inspection in a single facility. However, while the Health Department was interested primarily in the issues and problems associated with vehicle emission testing, the Revenue Department was interested primarily in updating and revising the existing vehicle safety inspection program. Consequently, neither study was funded sufficiently to investigate the feasibility of performing both safety and emissions inspections in either privately-operated, licensed stations or state operated inspection facilities.

3.2 STUDY OBJECTIVE

The purpose of this study is: 1) to update the findings of the two previous submittals; 2) to identify the factors and determine the costs associated with an integrated safety-emissions inspection program; 3) to evaluate public attitude with respect to vehicle inspection; and 4) to assess legal changes necessary for a vehicle modification program.

3.3 STUDY CONDUCT

The general study approach was to review the data used in the previous two studies, update the findings based on any data revisions, evaluate the results to ascertain whether previous conclusions should be modified, and evaluate previous recommendations to determine if any additional ones were warranted. Summarized below are the general areas of investigation and the applicable study approach. Sections 4 through 7 include the detailed analysis and results.

3.3.1 Vehicle Safety and Emissions Inspection

The previous study for the Motor Vehicle Division (Ref. 3) resulted in the following general conclusions:

- The public opinion survey indicated that vehicle owners' attitudes are favorable to the existing safety inspection. Vehicle owners feel that the program is effective, necessary, and adequately implemented. They are in favor of an improved inspection program, but are divided on the subject of an increased inspection fee.

- A major change to the existing safety inspection program at that time would not be in the best interest of vehicle owners, inspection station operators, or the program itself. The reasons for this position were: 1) lack of firm, existing National Highway Traffic Safety Administration standards; 2) lack of conclusive evidence that State-operated facilities are more effective than privately-operated stations; and 3) public acceptance of the current safety program.

- The current safety inspection procedure and the required instrumentation allow excessive arbitrariness in interpretation and implementation of vehicle safety inspection. The current procedure contains outdated and redundant inspection information and can be improved by reorganization, revision and procedural format changes.

The recommendations from this MVD study were directed toward the areas of inspection procedures, inspection equipment, integration of safety and emission inspection, and noise inspection. These recommendations are summarized below.

- The existing procedure should be reorganized and reformatted. The restructured procedure should define the component or function to be inspected, the approved equipment to be used and the rejection limits. These individual inspection functions should be grouped into families and compiled in a binder which allows convenient editing by adding or deleting sections and/or pages. The recommended preliminary safety procedures, reorganized and reformatted, were appended to that report. It was further recommended that the procedures be finalized as part of a continuing task.

- Section X (Tools and Equipment) of "Rules, Regulations, Requirements for Motor Vehicle Official Inspection Stations" should be revised to be compatible with the recommended inspection procedure. The recommended list, as appended to that report, was to provide minimal safety inspection equipment and tool investment, maintain correlative inspections, and reduce the number of inspection rejections which were determined previously by inspector judgment.

- The Idle exhaust emissions inspection should be initiated in a minimum of 561 official safety inspection stations distributed throughout the State capable of measuring HC and CO. Inspection failure limits for HC and CO should be established by the Colorado APCD.

- Noise monitoring of in-use vehicles should be limited to the physical inspections of the condition of the original vehicle equipment intended to suppress noise. Lack of proven techniques and measurement equipment for inspection purposes precluded recommending any instrumented testing at that time.

Since the submittal of that earlier study, the NHTSA has promulgated the vehicles-in-use safety inspection standards (Ref. 1). Section 4 compares these Federal standards with the Colorado standards.

The previous study for the Health Department (Ref. 5) arrived at the following general conclusions:

- Vehicle emissions of HC and CO at Colorado altitudes are significantly higher than at low-altitude cities.

- Periodic vehicle emission inspection, coupled with emissions-oriented maintenance, is one feasible approach to achieving reductions in emitted HC and CO.

- Key Mode inspection, which involves testing the vehicle under dynamic simulated road-load conditions using a chassis dynamometer, is more effective than Idle inspection.

- For emissions inspection only, State-operated facilities are more cost effective than privately-operated facilities.

- The private sector should perform emission-oriented maintenance regardless of which sector performs the inspection.

- Installation of emission control systems on pre-1968 vehicles on a retrofit basis appears to be another technically and economically feasible approach to emission reductions. Further testing of selected systems was recommended at various Colorado altitudes.

- The high altitude modification packages designed by Pontiac Motor Division in Denver appear to be effective in reducing the emissions of 1972 GM vehicles. Further testing was recommended on other vehicles at various Colorado altitudes to validate this approach.

- The opinion survey of urban and rural Colorado residents determined that the majority of the residents (72 percent) identify the automobile as the greatest contributor to air pollution.
- The majority of the residents (81 percent) would approve of a vehicle inspection and control program.
- The majority of the residents (65 percent) feel that all vehicles, regardless of age, should have emission control systems installed.
- Residents were divided on who should conduct emission inspections, with 49 percent favoring private stations, 44 percent favoring State operation, and 7 percent undecided.
- Residents expressed a definite lack of knowledge concerning the cost of emission-oriented vehicle maintenance. Seventy-eight (78) percent did not know what a realistic amount should be.

Based on that study results and the conclusions, the following recommendations were made:

- Conduct a pilot Idle emission test program involving at least three Air Quality Control Regions (AQCR), metropolitan Denver being one of these. The other two should be selected according to the mean altitude of principal cities. This pilot program should include all facets of a statewide program encompassing inspector training approved test procedures and instrumentation, selected sample vehicles, pre-established emission failure limits, and data collection, analysis, and interpretation.

- Develop a public indoctrination program to inform the residents of the implementation plan, the benefits of emission inspection and maintenance, the approximate costs to the vehicle owners, and the similarities and differences between vehicle safety and emission inspections.

- Review existing and proposed consumer protection plans relative to: 1) unfair practices in vehicle inspection and vehicle service and repair; 2) penalties for non-compliance; and 3) procedures for requests-for-waivers and filing of complaints. Plans should be summarized and communicated to the general public.

- Design and conduct a study project to evaluate retrofit device effectiveness at higher altitudes. Similarly, a study project should evaluate the effectiveness and associated costs of vehicle engine modification packages.

- Develop or strengthen the APCD's capabilities to evaluate existing and future vehicular emission control concepts and systems, to assess after-market devices, to evaluate emission measurement instrumentation, to remain continuously cognizant of emission control strategies and federal standards, and to conduct investigations on research and development projects related to vehicle emission reduction.

- Compile and analyze pilot program data to verify emission altitude relationships, modify as necessary, and arrive at inspection failure criteria for statewide implementation.

The above conclusions and recommendations were the bases for much of the study areas investigated and discussed in this final report. Section 4 that follows describes the costs of a program involving vehicle safety combined with Idle emissions inspection. Estimates are calculated for both annual and semi-annual inspection in State-operated facilities and in licensed stations. State administrative functions are defined and cost-estimated for both alternatives.

3.3.2 Public Opinion Surveys

Three public opinion surveys conducted in Colorado during 1973 are reviewed. The results are evaluated and compared in Section 5. Each survey was designed to accomplish different objectives. However, the three have many similar questions. The analysis was directed primarily toward assessing public attitudes regarding vehicle inspection. Secondarily, opinions related to other emission control strategies were evaluated. "The State of Colorado Air Pollution Control Transportation and Land Use Plan," as submitted to the U.S. Environmental Protection Agency in May 1973, was used as a source for identifying emission control strategies currently being considered by the Department of Health (Ref. 15).

3.3.3 Vehicle Owner Considerations

Vehicle owner considerations are evaluated in Section 6 to assist in defining the program management functions. Of primary concern is consumer protection. Consequently, the areas of discussion dealt with certified inspection stations, uniform procedures and qualified personnel, public display of labor rates and inspection signs, preparation of written preliminary cost estimates, replacement parts, and procedures for filing waiver requests and malpractice complaints.

3.3.4 Legislative Considerations

Various vehicle engine modifications and retrofit devices are described and evaluated in other volumes of this report. The legality of these modifications and device installations are discussed in Section 7. Several of the leading vehicle manufacturers, both domestic and foreign, were queried as to the possibility of warranty voidance because of post-delivery vehicle modifications. Their replies are discussed in Section 7.

SECTION 4

VEHICLE SAFETY AND EMISSION INSPECTION

This Section identifies and evaluates the federal and Colorado requirements for vehicle safety inspection. Various inspection task times are estimated, generic inspection instrumentation is defined and the costs estimated, and facility and personnel requirements are defined. Similarly, the requirements of a program involving vehicle emission testing and maintenance are evaluated and their costs estimated. A program involving the integration of vehicle safety and emission testing, as performed in privately-operated facilities, is then evaluated. Also, for comparative purposes, the same integrated testing program performed in State-operated facilities is described and analyzed.

4.1 VEHICLE SAFETY INSPECTION

The objectives of any motor vehicle safety program are to identify serious deficiencies in safety-related components of vehicles and to effect the required corrective measures. A major task, however, is to identify and select those vehicle properties that deteriorate with use or time and which may endanger the vehicle occupants and the general public. Of equal importance, is the design and selection of an organized method of detecting these deteriorated conditions considering a reasonable investment in time, money, and effort.

4.1.1 Federal Inspection Standards

The U.S. Department of Transportation, through the National Highway Traffic Safety Administration (NHTSA), has issued the Vehicles-in-Use Inspection Standards (Ref. 1). As stated in the foreword to the standards, the NHTSA does not intend these in-use standards to supplement existing State standards which establish a higher performance. Additionally, the federal standards do not preclude states from establishing or maintaining standards for other vehicle systems not specifically covered by the NHTSA inspection standards. As issued, the initial federal standards are intended to cover those vehicles and systems whose maintenance in good order have proven to be critical in the prevention of traffic accidents.

The NHTSA inspection standards and procedures have been adopted for the hydraulic service brake systems, steering and suspension systems, and tire and wheel assemblies. Requirements for less critical vehicle systems are under study; and the NHTSA intends to take further action as may be appropriate to cover them (Ref. 1). Appendix A summarizes the inspection standards as published in the Federal Register.

4.1.2 Colorado Inspection Standards

The Department of Revenue, Motor Vehicle Division, administers the vehicle safety inspection program. Vehicles are inspected twice a year by licensed facilities following the procedures and policies promulgated in the "Rules, Regulations and Requirements for Motor Vehicle Official Inspection Stations" (Ref. 2). The Colorado inspection standards and procedures include the following vehicle systems: wheels and tires; steering, alignment and suspension; brakes; lighting and electrical; exhaust and fuel systems; body and sheet metal; and speedometer.

The Motor Vehicle Division has reviewed the current rules and regulations to determine the adequacy and shortcomings of the procedures and inspecting instrumentation (Ref. 3). The analysis and evaluation resulted in methods of improving safety inspection effectiveness through procedural, instrumentation, and documentation changes. It should be noted that these recommendations were the result of an in-depth investigation of existing studies and State standards, and was performed approximately a year before the aforementioned federal inspection standards were recorded in the Federal Register. As such, the recommended procedures are much more detailed than those in the federal standards. However, a few items listed in the federal standards do not appear in the Colorado standards.

For example, the federal standard requires at least one front and one rear wheel be removed for visual examination of brake system components. Current Colorado standards require at least one front or one rear wheel be removed. Also, there are several differences in the test variable using the same test methods. For example, pedal force exerted over a specified time period may differ between federal and Colorado standards; however, the test procedure is similar. In general, Colorado test requirements are more detailed but not necessarily more stringent than the federal requirements.

Appendix B contains the recommended inspection procedure, equipment, and rejection limits as extracted from the referenced study performed by Olson Laboratories under contract with the Motor Vehicle Division.

4.1.3 Estimated Inspection Task Time

Appendix C contains the detailed analysis of inspection task times. These estimates are based on previous work-study programs, discussions with equipment manufacturers, and observations of inspection sites.

Table 4-1 shows the estimated elapsed time for one vehicle to be inspected in accordance with both the federal and Colorado standards. Note that the Colorado standards include all requirements suggested by the federal in-use vehicle standards plus others.

The inspections performed according to the federal standards would require about 10 minutes of an inspector's time. This assumes that all test equipment is available and operational for his immediate use. To perform the inspections according to Colorado standards, approximately 13 minutes of an inspector's time would be required. Again, this assumes uninterrupted inspection and all test equipment available and operational. If two wheels are removed instead of only one, as currently required, then roughly 14 minutes (12.6 original plus 1.5 additional) of an inspector's time would be required.

4.1.4 Safety Inspection Equipment

Based on the analysis of Colorado inspection standards, a revised equipment list was recommended in the study performed for the Motor Vehicle Division (Ref. 3). Appendix D includes the recommended equipment list for privately-operated, safety inspection stations. The equipment and tool list reflects those items necessary to ensure that every inspection station has the capability of performing vehicle inspections as specified by the recommended procedure. This recommended list is designed to provide minimal safety inspection equipment and tool capital investment, maintain correlatable inspections, and reduce the number of inspection rejections which are now determined by inspector judgment.

Table 4-1. ESTIMATED INSPECTION TIMES*

Vehicle System	Time (minutes)	
	Federal Standards	Colorado Standards
Service Brake	4.0	2.5
Brake Power Unit	0.5	0.5
Steering System	1.0	1.0
Suspension System	0.5	0.5
Tires	0.5	0.5
Wheel Assemblies	1.0	1.0
Lighting and Electrical		1.3
Glazing		0.2
Body and Sheet Metal		0.5
Exhaust and Fuel System		1.0
Inspection Subtotal	7.5	9.0
Vehicle Receiving	0.3	0.3
Vehicle Certification	1.3	1.3
Non-Functional Time	1.0	2.0
Inspection Total	10.1	12.6

*See Appendix C for detailed analysis.

4.1.5 Estimated Safety Inspection Cost

The federal vehicle in-use inspection standards do not mandate any new safety-related vehicle testing. Accordingly, privately-operated inspection stations in Colorado are not required to invest in additional instrumentation. Assuming that flat rate labor charges remain unchanged, the inspection fee can be approximated on labor charges only. Based on a limited survey of service facilities, a representative labor charge in Colorado is estimated at $10 per hour. This labor rate is based on station personnel wages, benefits, equipment and building depreciation, and other operating expenditures.

Considering the uncertainty of cost escalation, the variation in labor rates, and the variability of personnel task times, the estimated time for performing the federal and Colorado inspections is increased by 15 percent. Consequently, the time to perform the federal procedures is increased to 12 minutes and the Colorado procedures to 16 minutes. The resulting inspection fees would then be as follows:

$$\text{Federal Procedures Fee} = \frac{12}{60} \times \$10 = \$2.00$$

$$\text{Colorado Procedures Fee} = \frac{16}{60} \times \$10 = \$2.65$$

Currently, the inspection stations pay the State $0.25 for each inspection sticker. The income from the stickers pay the State expenses for managing the statewide program. Assuming that State expenses will not increase because of the new procedures, then it can be assumed that the sticker cost will remain unchanged. Thus, the new estimated inspection fees would be:

$$\text{Federal Procedures Fee} = \$2.00 + \$0.25 = \$2.25$$

$$\text{Colorado Procedures Fee} = \$2.65 + \$0.25 = \$2.90$$

The validity of this assumption regarding State expenses will be analyzed in a subsequent section.

4.2 VEHICLE EMISSION INSPECTION

Many studies and experiments have been conducted to determine the effectiveness of vehicle emission inspection and maintenance. The consensus of findings has been that regular and periodic service and repair of emission-related vehicle components has benficial effects in reducing exhaust emission of all light-duty vehicles, whether emission-controlled or uncontrolled. Recognizing these benefits, both governmental agencies and private businesses have conducted further investigations to determine the more effective methods of conducting inspection and maintenance.

In one of these investigations, five alternative inspection/ maintenance concepts were evaluated for possible statewide implementation (Ref. 4). Of the five alternatives, Idle test and Key Mode test were determined to be the most feasible for a state program both technically and economically.

Recently, the State of Colorado, Department of Health, contracted with Olson Laboratories, Inc., to evaluate the costs, benefits, and public acceptability of instituting a statewide vehicle emission control program of inspection and maintenance. Additionally, as a secondary control measure, the State desired to determine the feasibility of requiring the installation of exhaust emission controls on a retrofit basis (Ref. 5). The following paragraphs present a summary of the findings from this previous study. Where applicable, recently acquired data from other studies are included. Because the information presented is in summary form, it would be advisable for the reader to refer to the original study in order to grasp fully the study scope, methodology, and context from which these results were taken.

4.2.1 Evaluation of Emission Inspection Procedures

Two inspection procedures were evaluated — Idle and Key Mode. Idle emission testing requires sampling the exhaust emission of a vehicle during curb idle and also with the engine running at 2,500 rpm and the transmission in neutral. The sample is analyzed for levels of hydrocarbons (HC) and carbon monoxide (CO). See Appendix J for a copy of the Idle Emission test procedures.

Key Mode testing involves running the vehicle under dynamic, simulated, road-load conditions using a chassis dynamometer. Sampled exhaust emissions are analyzed while the vehicle is operated under conditions of idle, high cruise (approximately 50 mph) and low cruise (approximately 30 mph). Gas analysis is done for levels of HC and CO. Under these simulated road-load conditions, oxides of nitrogen (NO_x) also may be analyzed with proper instrumentation.

4.2.2 Inspection and Maintenance Effectiveness

The initial study report and the findings were needed to satisfy certain legislative requirements. Time and economic constraints precluded the inclusion of an experimental phase during which assorted vehicles could undergo emission testing and servicing. Also, it was concluded that sufficient test data existed from other studies to provide the necessary data base for the investigation.

Information on emission testing and maintenance relative to various operating altitudes was acquired from the State of Arizona

Department of Health, Air Pollution Control Division, Vehicular Emissions Control Section. Data on several thousand vehicles tested at various altitudes ranging from near sea level (Yuma at 140 feet), to 6,900 feet (Flagstaff), were processed by the Colorado APCD.

Additional emission test data were acquired in Denver at 5,280 feet and at Alamosa at 7,540 feet. The mobile van for emission testing was provided by the State of Arizona through arrangements by the Colorado Air Pollution Control Commission.

Through special arrangements with the EPA, Region VIII, Denver, the results of an emission test program involving 75 emission controlled vehicles (1968 to 1972) were available for inclusion in the study. Other EPA studies performed by Olson Laboratories as part of the national surveillance program also were referenced for emission test data involving Denver vehicles as well as cities such as Los Angeles, Detroit, Houston, and Washington, D.C. Vehicles for these surveillance programs included 1968 through 1971 models.

Another source of data was the recently completed study (1971) performed in California for the Air Resources Board which involved testing 1,100 vehicles of model years 1955 to 1970 (Ref. 4). All of these data were used in conjunction with another EPA study, the Short Cycle Project (Ref. 6), to arrive at a composite representation of vehicles operating at various altitudes similar to that of Colorado. Regression equations were developed to establish the relationship between emission levels of HC and CO as a function of operating altitude for various emission control vehicle classes.

Table 4-2 shows the average expected emission reductions for serviced vehicles only, (i.e., those inspected vehicles that exceed the established limits and are subsequently serviced and/or repaired to satisfy these limits).

Table 4-2. EMISSION REDUCTION FOR SERVICED VEHICLES ONLY

Inspection	Emission Reduction (Percent)		
	HC	CO	NO_x
Idle	45	34	- 6*
Key Mode	58	47	-14

*Minus sign denotes increase.

Table 4-3. EMISSION REDUCTION FOR TOTAL VEHICLE POPULATION

Calendar Year	Idle Test*		Key Mode*	
	HC	CO	HC	CO
1974	5.1	6.8	8.8	7.1
1976	4.7	7.0	8.4	7.0
1979	4.2	6.8	7.6	6.7
1982	3.5	6.0	6.7	5.7

*HC and CO reductions are in percentage of total emissions before inspection and maintenance. Emission limits set to fail 30 percent of inspected vehicles, reductions include 50 percent degradation.

While significant changes can be expected for individual vehicles, as shown in Table 4-2, it must be recognized that in an inspection/maintenance program, not all vehicles will be or need to be serviced. The number of serviced vehicles is related to the rejection limits established. These limits in turn establish the program effectiveness (emission reduction measurement).

The effects of varying the emission limits such that various proportions of vehicles fail the inspection were analyzed also using the composite data with particular emphasis on the recent EPA Short Cycle Study (Ref. 6). The analysis indicated the following could be expected for a statewide program:

- Both Idle and Key Mode emission inspection, followed by emission-oriented maintenance of failed vehicles, will result in reductions of HC and CO. If implemented on a statewide basis, the resulting change in HC and CO emitted by light-duty passenger vehicles (roughly 1.2 million) will be as shown in Table 4-3.

  The emission reductions (percentages) are based on establishing emission limits such that 30 percent of inspected vehicles will require maintenance. In accordance with the EPA recommendations, a 50 percent degradation factor has been included (Ref. 7). Vehicle population, annual growth, model-year distribution, and vehicle mileage as a function of age were varied to reflect historical federal and State trends.

- The EPA Short Cycle Project (Ref. 6) concluded that emission reductions realized from 50 percent rejection would not be much higher than from a 30 percent rejection for either Idle or Key Mode inspection and maintenance. As a matter of interest, the

Short Cycle Project results are those cited in the EPA Implementation Plan requirements (Ref. 7).

- The effectiveness of an inspection-and-maintenance concept may be enhanced by decreasing the inspection interval. This, however, is related to vehicle emission deterioration with time and/or mileage. As noted earlier, the EPA currently suggests a straight-line, 50 percent degradation following maintenance (Ref. 7). More definitive deterioration factors may be forthcoming from a study currently in progress by the Colorado APCD, the results of which are due in June, 1974. As part of a previously completed study (Ref. 4), Olson Laboratories evaluated 552 vehicles which were serviced and retested approximately three to eight months following the respective servicing. Results were somewhat inconclusive due to the limited operating time and the fairly wide scatter of data points. However, using the least-squares method to linearize the plots, the results indicated that for 10,000 miles, the expected degradation would be 25 percent for HC and 44 percent for CO, with NO_x decreasing by 17 percent.

Olson Laboratories currently is conducting a degradation study that involves 432 vehicles. The program will be conducted over 18 months; and each vehicle will have its exhaust emissions sampled once every three months. The vehicle fleet will be comprised of 1968 to 1974 model years equally divided into three control groups. Results of this study will be available in 1975.

High Altitude Emission Inspection and Maintenance — Volume II of this report describes the pilot program which was conducted to evaluate the costs and effectiveness of vehicle Idle emission testing coupled with related maintenance is performed in the Denver area. The program involved 300 sample vehicles which were tested initially by Automotive Testing Laboratories (ATL) to establish the emission baseline profile. Vehicles were then dispatched to one of ten service stations, independent garages, or manufacturers' dealers having pre-trained technicians. Using the inspection procedures similar to those in Appendix J, the service representatives performed the test procedures and the necessary maintenance as required. A post-maintenance emission test was then performed by ATL to establish the changes in baseline profile.

The following summary observations were noted during the test program. For more detailed information, the reader should refer to Volume II.

- Emission reductions of HC, CO and NO_x are improved with increasing failure rates, as shown below.

Rejection Rate (Percent)	Emission Reduction (Percent)		
	HC	CO	NO_x
20	7.6	3.5	0.7
30	10.5	5.5	1.1
40	11.2	6.8	1.4
50	12.7	8.3	1.2
60	13.2	9.2	1.8

- Inspector training was adequate but could be improved in areas such as knowledge of emission control system concepts and necessity for proper data recording and forwarding.

- Emission test data correlation between the control laboratory (ATL) and the service stations indicated the need for improvement in correlatable emission measurements between similar instrumentation.

- In general, emission limits established to fail or reject a given proportion of inspected vehicles should yield the desired rejection rate. Factors that tend to cause deviations from the desired rate of failures are: (1) expected statistical variations in vehicle emissions based on fleet sample size; (2) instrumentation calibration and correlation to laboratory standards; and (3) inspection personnel work habits as influenced by training, experience and motivation.

4.2.3 Inspection Fee and Maintenance Cost Estimates

Two major costs to the vehicle owner are the vehicle emission inspection fee and vehicle repair and service costs to meet the State-established emission standards. The inspection fee may be estimated by using standard labor rates, as in a privately-operated service facility, or by allocating the cost per vehicle, as in a State-operated inspection facility.

In the previous study for the State of Colorado, it was determined that the following inspection fees could be expected in State-operated, emissions-only, inspection facilities: Idle, $2.10 per annual inspection; Key Mode, $2.67 per annual inspection (Ref. 5). For the inspections to be performed by licensed, privately-operated inspection facilities, the Idle inspection fee would be $5.45 and Key Mode would be $8.91 for an annual inspection. These fees for private facilities included all costs — direct labor, overhead and State administration. The latter cost would be similar in nature to the current compliance sticker cost ($0.25), but would be relatively higher.

Costs incurred by the vehicle owner for maintenance to satisfy emission standards will vary according to vehicle size, state of repair, accumulated mileage, and previous maintenance practices. Many investigations have been made of the associated factors of various directed-maintenance activities to determine the more cost-effective vehicle service/repair procedures, emission reductions, and owner costs (Refs. 4; 5; 6; 7; 8). Due to the wide-ranging objectives of these studies and others, plus the different time periods and locations where these investigations were conducted, placing a firm cost estimate on owner costs is difficult. However, deriving a range of values for vehicle classes is possible. Listed below are the expected owner costs for vehicle maintenance. Note that these are cost ranges for typical vehicles. Vehicles requiring minor adjustments may incur servicing costs of $5 to $10, whereas some vehicles requiring major work can expect costs of $100 to $150.

EXPECTED VEHICLE MAINTENANCE COSTS

Inspection	Pre-1968	1968 to 1972
Idle	$25-34	$17-36
Key Mode	17-36	13-30

As part of the previous study (Ref. 5), 288 dealers were queried on several aspects of vehicle maintenance practices and costs. These are listed below in Table 4-4.

Table 4-4. SURVEY RESULTS OF MAINTENANCE COST ESTIMATES

Action	Range (Dollars)
Minor Engine Idle Adjustments	5- 8
Major Electrical Tune-Up (plugs, points, condenser, idle adjustment)	15-35
Minor Carburetion (air filter replacement, PCV, choke adjustment)	4- 8
Carburetor Modification (jet change, float adjustment)	7-13
Major Carburetion (overhaul or replacement)	40-47

Inspection Costs Incurred During Pilot Test Program — Volume II of this report details the inspection and maintenance costs actually expended during the 300-car pilot test program. To perform the Idle emission test, the service stations charged an average of $4.05 per vehicle. The inspection charges by individual station ranged between a low of $1.50 per vehicle to a high of $6.00 per vehicle.

For vehicles receiving maintenance and repair, the average cost was $10.57 per vehicle. The range of average maintenance cost by individual stations varied from a low of $2.53 per vehicle to a high of $14.25 per vehicle.

The inspection costs are relatively consistent with findings noted in this study and others. However, the maintenance costs appear to be relatively low as compared with those noted above which reflect the composite of several similar experimental investigations. When viewed in light of the data presented in Table 4-4, it is reasonable to assume that the majority of serviced vehicles received minor engine idle adjustments and/or minor carburetion adjustments and parts replacement.

4.3 VEHICLE RETROFIT AND MODIFICATION

Vehicle exhaust emissions may be reduced by the installation of selected retrofit devices and/or engine modifications. The Federal EPA evaluated over 60 retrofit devices during a recent study (Ref. 9). The devices and modifications were tested on previously uncontrolled vehicles (pre-1966 models) with emission testing done near sea level conditions. Consequently, further testing was recommended during the earlier Colorado study (Ref. 5) to validate the findings at higher vehicle-operating altitudes and to extend the investigation to include controlled vehicles.

4.3.1 Retrofit Effectiveness Analysis

The EPA study (Ref. 9) concluded that for previously uncontrolled vehicles, exhaust emission may be reduced by retrofit devices and/or engine modifications. In general, the more sophisticated approaches prove to be highly effective with correspondingly higher vehicle-owner costs. Several approaches exhibited relatively good effectiveness measures (emission reduction) and reasonable owner costs. These retrofit approaches are:

- Ignition timing modification with lean idle adjustment
- Exhaust gas recirculation (EGR)
- Vacuum advance disconnect (VAD)
- EGR combined with VAD

For a statewide implementation of retrofit device installation on pre-1968 automobiles only, the emission reduction estimates would range between 1.5 to 2.5 percent in HC during 1976 down to 0.5 to 0.9 percent in 1982. Similarly for CO, the estimated reductions would be 3.8 to 5.6 percent in 1976 down to 1.5 to 2.2 percent in 1982. These reductions include a 50 percent degradation factor. Without degradation, the reductions essentially would be twice as much. These reductions are based on the expected total vehicle population and model year distribution anticipated during the future years. Consequently, the effectiveness initially is small because of the quantity of pre-1968 vehicles in operation. Also, the emission reductions realized in succeeding years decreases further because of the rapid attrition of vehicles after about 6 to 7 years of model introduction. As an example, historical data have shown that roughly 93 percent of a particular model are still registered 7 years after production. However, only 47 percent are in operation 3 years later (after 10 years), and 17 percent after 13 years (Ref. 10).

The effectiveness of a retrofit program may be enhanced considerably if the remaining vehicles, 1968 and newer, could be similarly equipped. Alternative methods for these newer vehicles were evaluated and discussed in other volumes of this report.

In selecting the approaches for vehicle retrofit, several factors contribute toward establishing technical and economic feasibility. The EPA study previously cited (Ref. 9) identified the following:

- Emission reduction effectiveness — The capability to reduce vehicle emissions of HC, CO and NO_x for various model years.

- Driveability and safety — Effect on vehicle performance characteristics such as starting, idling, acceleration, and fuel economy; and effects or presence of safety hazards to vehicles or occupants due to device installation.

- Reliability – The calculated mean-miles-before-partial or total failure of the retrofit device as a function of vehicle cumulative mileage.

- Maintainability – A measure of the amount of maintenance required to sustain desired performance of the device, as stated in terms of periodic preventive maintenance and corrective maintenance labor and materials.

- Installation requirements - Defined in terms of special equipment, technical skills, and expended time necessary to complete the installation and checkout of the device.

- Motorist costs – Stated in terms of initial cost (acquisition and installation) and recurring cost (maintenance and performance penalties).

4.3.2 High Altitude Retrofits and Engine Modifications

Volume II of this final report describes the pilot program to assess the effectiveness of several emission control strategies involving vehicle retrofitting and engine modifications. Fifty vehicles previously cycled through the Idle inspection and maintenance test program were selected to represent a cross-section of the more popular vehicles. The following vehicle modifications were selected for evaluation:

Generic Description	Model Year Vehicles Modified
Catalytic Converter	1968-1972
LPG Fuel System	1968-1972
Air Bleed	1968-1972
Carburetor Float Bowl Pressure Regulation	1968-1972
Air Bleed with Exhaust Gas Recirculation (EGR)	1964-1972
EGR	1968-1972
Air Bleed with Vacuum Spark Advance Disconnect (VSAD)	1964-1967
EGR with VSAD	1964-1967

The sample vehicles were inspected, malfunctions corrected, marginal parts replaced, and engines adjusted to meet manufacturers' specifications. Retrofit devices were installed by their respective representatives after which emission measurements were made. Driveability testing and performance assessment followed the procedures described in Volume II. Results of the evaluation phase also are presented in Volume II. A summary of the findings are extracted and listed below:

- A catalytic converter system requires a relatively large amount of installation time and effort if the vehicle is not previously equipped with air pump. The expected cost range is $55 to $155 per vehicle. Roughly 60 percent of 1968 to 1970 vehicles can be modified with these systems, as well as about 75 percent of the 1971 vehicles, and essentially all newer vehicles. Converters require that the vehicle use low lead or non-leaded gasoline. Emission reductions are on the order of 72 percent for HC, 84 percent for CO, and an expected increase in NO_x of 3 percent.

- LPG systems require the installation of a supplemental fuel tank especially designed for the higher vapor pressure experienced by LP gas; and the carburetor must be replaced with one designed for the LPG. System suppliers believe that conversion of fleet vehicles having high utilization (about 25,000 miles per year) would be most feasible. Installed cost is estimated to be about $650 per vehicle, highest of all retrofit systems evaluated. Emission reductions expected are 41 percent for HC and 54 percent for CO with a nominal 4 percent increase in NO_x.

- Air Bleed systems can be installed on nearly all light-duty vehicles with few exceptions. It was the least costly retrofit system evaluated, having an estimated installed cost of $20 per vehicle. Emission reductions expected are 18 percent for HC, and 42 percent for CO, whereas NO_x is expected to increase by 24 percent.

- Carburetor Float Bowl Pressure Regulation systems can be installed on all light-duty vehicles with few exceptions. The estimated installed cost is $24 per vehicle. The emission reductions are estimated to be 18 percent for HC and 30 percent for CO with an expected increase of 23 percent for NO_x.

- Air Bleed with EGR systems can be installed on all 1964 to 1972 vehicles except those equipped with fuel injection or multiple carburetors. The installed cost is expected to be about $35 per vehicle. For the 1964 to 1967 vehicles, the emission reductions would be 22 percent for HC, 21 percent for CO, and 25 percent for NO_x. Similarly, for the 1968 to 1972 vehicles, the reductions would be 17 percent for HC, 48 percent for CO, and 29 percent for NO_x.

- EGR systems can be installed on all vehicles of the model years 1964-1972 except those with special carburetion systems, as noted above. The average installed cost would be $32 per vehicle. The estimated average emission reductions would be seven percent for HC, two percent for CO, and 43 percent for NO_x. Additionally, a relatively large penalty on the order of a nine percent decrease in fuel economy may be experienced.

- Air Bleed with VSAD systems may be installed on all 1964 to 1972 vehicles except those not equipped with vacuum spark advance. The expected installed cost would be $25 per vehicle. The emission reductions would be about 19 percent for HC, nine percent for CO, and 47 percent for NO_x. A fuel economy decrease of about 8 percent may be expected.

- EGR with VSAD systems may be installed on all 1964 to 1972 vehicles except those not equipped with vacuum spark advance. The installed cost would be $25 per vehicle, on the average. Expected emission reductions would be about 26 percent for HC, 11 percent for CO, and 28 percent for NO_x.

4.3.3 High Altitude Manufacturers' Kits

As described in Volume II of this report, 100 of the 300 vehicles previously processed through the Idle inspection phase were selected to be modified with kits supplied by the domestic vehicle manufacturers. Only 1968 to 1973 vehicles were used during this evaluation. The kits included various carburetor and distributor replacement parts. Installation procedures also included readjusting ignition timing and idle adjustments. See Volume II for specifics on altitude modification kits. The vehicle test sequence was the same as that followed for the retrofit vehicle sample. The observations and findings as detailed in Volume II are summarized below.

- High altitude kits provided by General Motors, Ford, and American Motors were equally applicable to all of their respective 1968 to 1973 models, with few exceptions. Kits provided by Chrysler Corporation, however, were limited to vehicles equipped with Carter two-venturii carburetors only.

- No special training of installers was required by manufacturers, nor were any installation procedures or guidelines included with the kits. Several vehicle owner complaints on vehicle operation subsequent to modification could be attributed to contamination of carburetor choke and linkages, and distributor mechanisms. Additional sources of dissatisfaction were attributed to related settings, adjustments or parts which were marginal initially and were negatively affected by the modifications or by the modification process.

- The high altitude kits required from 30 to 50 minutes for installation. The parts cost from $0.30 to $3.80 depending on vehicle manufacturer and type. For this pilot program, the average cost to modify the vehicles ranged from $3.90 to $13.60 installed. It is expected that these costs would be relatively higher if installment was required for the public sector in general without more specific, detailed instructional procedures.

- The American Motor's high altitude kits, as applied to a sample of four vehicles, included a change in the metering jet, an advance in ignition timing, and general idle adjustments. The kits resulted in increases of 9 percent in HC, 12 percent in CO, and 17 percent in NO_x.

- The Ford Motor Company kits, as applied to a sample of 28 Fords and eight Mercurys, included changes in fuel metering jets and power valve assemblies, an advance in ignition timing, a modification to the choke setting, and idle adjustments. For the 28 Fords that were modified, the emission reductions were 0.5 percent in HC and 8 percent in CO, with an increase of 20 percent in NO_x. Similarly, for the eight Mercurys, the reductions were 2.5 percent in HC and 13.5 percent in CO, and an increase of four percent in NO_x.

- The General Motors kits, as applied to 48 vehicles, included recalibration of the distributor vacuum advance, modification to lean power enrichment springs, and general idle adjustments. In general, the kits tended to increase HC emissions by six to eight percent, decreased CO emissions by three to 18 percent, and increase NO_x by 19 to 23 percent. A notable exception were the two modified Cadillacs which exhibited an HC increase of 49 percent, a CO reduction of 23 percent, and an NO_x increase of 139 percent.

- The Chrysler Corporation kits, as applied to 15 vehicles, included a change to leaner fuel metering jets, a change in fuel mixture enrichment springs, an advance in ignition timing and general idle adjustments. In general, the modifications to the Plymouths and Dodges resulted in reductions of HC of 28 to 33 percent, 54 to 60 percent reduction in CO, and increases of 80 to 98 percent in NO_x. The single Chrysler in the sample exhibited an increase of 77 percent in HC, a decrease of six percent in CO, and an increase of 40 percent in NO_x after modification.

4.3.4 High Altitude Modified Engine Tuning

Volume II describes the experimental program to assess the effectiveness of various engine parameter adjustments as performed individually and in combinations. Of the 300-vehicle sample, a subset of 25 were selected for this assessment. The four basic engine variables related to vehicle emissions selected for evaluation were as listed below:

- Vacuume choke kick which was set leaner than manufacturer's specification.

- Basic ignition timing which was advanced eight degrees from manufacturer's specification.

- Idle air/fuel mixture which was set leaner than manufacturer's specification as expressed in a decrease of idle speed by 200 rpm. The drop in idle rpm caused by leaning the air/fuel mixture was recovered by adjusting the idle speed screw.

- Basic idle speed which was adjusted for net increase of 200 rpm beyond manufacturer's specification.

The variables above are not independent. Because of known interactions, ATL developed an orderly sequence of adjustments. A set of eight sequences were determined; and the 25 vehicles were exposed to each of these sequences. The order in which each of these vehicles were sequenced, however, was selected at random. Results of the evaluation indicated the following:

- In general, the four basic engine variables, as modified individually, have little effect (about one percent or less change) on HC and NO_x. However, CO reductions on the order of 13-22 percent are achievable for each basic modification.

- Taken in combinations of two basic modifications, the results appear to be similar to those taken individually. Of the six combinations of two, HC changes were less than one percent increase or decrease, CO reductions ranged between 15 and 24 percent, and NO_x increased between 0.9 and 1.3 percent.

- These engine modifications in general led to some noticeable deterioration in driveability and performance.

- The costs associated with these modifications were not ascertained. Presumably they would be considered as normal labor incurred during engine tune up with no additional charges.

4.3.5 High Altitude Mandatory Engine Maintenance

A total of 158 vehicles from the 300-vehicle sample were used to evaluate this emission control concept. As described in Volume II of this report, the mandatory maintenance concept involves the following actions on all vehicles:

- Removal and replacement of spark plugs, distributor points and condenser, and carburetor air filter element.
- Adjustment of distributor dwell angle, ignition timing, idle speed rpm, and carburetor idle air/fuel mixture.

In a mandatory maintenance program, each of the above actions would be performed. However, during the actual experimental phase, only those items diagnosed to be marginal, malfunctioning, or misadjusted were corrected. It was assumed by the investigators that the replacement of acceptable parts would have minimal effects on the overall vehicle emissions.

- The estimated labor hours for mandatory maintenance, as determined from published information, range from 1.6 to 2.8 hours depending on vehicle make and number of engine cylinders. Based on existing rate of $12 per hour flat rate, the labor costs range from $19 to $34 per vehicle. Replacement parts costs range from $9 to $25. Total maintenance costs range from $33 to $59 per vehicle.
- For the fleet of 158 vehicles receiving mandatory maintenance, the fleet average emissions were reduced 19 percent for HC, nine percent for CO and eight percent for NO_x.

- Reliability — The calculated mean-miles-before-partial or total failure of the retrofit device as a function of vehicle cumulative mileage.

- Maintainability — A measure of the amount of maintenance required to sustain desired performance of the device, as stated in terms of periodic preventive maintenance and corrective maintenance labor and materials.

- Installation requirements — Defined in terms of special equipment, technical skills, and expended time necessary to complete the installation and checkout of the device.

- Motorist costs — Stated in terms of initial cost (acquisition and installation) and recurring cost (maintenance and performance penalties).

4.4 DATA AND INFORMATION PROCESSING

Data and the information derived from it are essential for both technical and administrative purposes. Technically, they are required to establish whether a vehicle satisfies the safety inspection standards and/or the emission standards. Administratively, the information is necessary to evaluate the effectiveness of the inspection program.

To satisfy these information requirements, one basic source of data exists — the test vehicle. Its data characteristics are grouped and identified as follows:

Administrative

- Vehicle owner name, address
- Schedule — last inspection, next inspection
- Vehicle registration number, license plates

Technical

- Model year and make
- Engine size and class
- Transmission class (manual, automatic)
- Mileage — last test
- Emission control type — engine modification, air injection, EGR, VAD
- Emission profile — last pass levels
- Service brakes — pass, fail
- Steering system — pass, fail
- Suspension system — pass, fail
- Tires — pass, fail
- Wheel assemblies — pass, fail
- Lighting and electrical systems — pass, fail
- Glazing — pass, fail
- Body exterior — pass, fail
- Exhaust system — pass, fail

At the inspection facility, acquired test data must be compared against predetermined emission limits to determine whether the inspected vehicle passes the test or requires some corrective measures. The method by which this determination is made is dependent on the sophistication of the data processing capabilities incorporated in the facility. Consideration also must be given to any subsequent data analysis and information retrieval required at State program offices.

4.4.1 Manual System

In a manually operated data processing system that would be typical of private garage operation, the technician notes and records test data from display meters. Referencing a set of tables or calibration charts, the technician then can ascertain whether the test vehicle emission levels comply with the appropriate limits as established for the particular model year, make, engine size, and emission control systems. Comparative results are noted in the inspection form, along with the decision (pass, fail), and next scheduled inspection date.

For vehicle safety inspection, the existing data forms may be used. However, if emissions inspection will be performed in conjunction with safety inspection, a new form would be required. To facilitate program monitoring, surveillance and appraisal, the new form should include the items identified earlier, as a minimum. The items may have further vehicle component descriptions to permit more detailed analysis of failure trends by vehicle system, component, manufacturer, model year or period. Results of the analysis could be used to validate initial inspection standards, propose revised standards for existing vehicles based on program objectives, and establish initial standards for current production models based on historical data.

Appendix K includes copies of inspection forms that are manually completed by inspecting personnel. One format used in the Washington, D.C., facility requires the inspector to signify failed items by punching the appropriate block. The form is a foldover type with both sides printed. When the form is folded over and punched, one half is given to the vehicle owner; and the other duplicate half is kept by the inspecting facility. At the inspecting facility, the inspection data is transferred from the punched card to the data processing system via a keyboard operator. In addition to safety and emissions inspection data, the D. C. form also includes information to denote whether the subject vehicle was previously involved in a traffic accident or was a manufacturer's recall.

Another inspection form included in Appendix K is that used in Ontario, Canada by the Department of Transportation. The form is completed in duplicates by the inspector marking those items found to be in non-compliance. As completed in governmental inspection stations, the original is issued to the motorist, and the copy is retained at the inspecting station.

4.4.2 Automated Systems

Some human factors consideration affect the data and information processing functions. The operator can degrade the system performance by incorrectly interpreting displays, by observing or implementing test procedures in an untimely manner, or by recording incorrect data.

In order to reduce operator stress, provide the most rapid data analysis and achieve lower error rate, some data and information processing functions might be automated. However, the functions should be evaluated in a wider perspective. That is, the inspection station data processing functions, together with the overall program management requirements, need to be analyzed as a whole to realize an economical and efficient implementation.

In an automated data processing system, typical of a state-operated facility the test measurements are combined with inspection vehicle identification data; and a pass-fail decision is generated based on established limits for a specific vehicle-engine class. Functions which also may be automated are printed records and vehicle scheduling. The capability of compiling emission and safety inspection data for analysis of program effectiveness could be included.

Appendix K includes a copy of the inspection form developed for the inspection facility that is to be operated for the New York City Taxi and Limousine Commission. The form is an example of a document to be completed by semi-automated means within a government-operated facility. Visual observations and decisions by inspectors will be input manually to the facility data processing system. Emission testing and speedometer-taximeter checking will be automated by interfacing with the on-line computer. Data comparison and interpretation and forms completion also are performed by the facility computer.

4.5 STATE PROGRAM ADMINISTRATION AND MANAGEMENT

Administration and management of a statewide emission and safety inspection program will include initial scheduling of vehicles, maintenance of records, establishment and review of emission limits, data analysis to determine the effectiveness of the inspection program, evaluation of current and future equipment needs, and provision for future analysis and development.

Where privately-operated, licensed facilities are needed to perform emission inspection and/or maintenance, program management functions include establishing qualification criteria, evaluating candidates and certifying and licensing qualified parties.

In order to assure uniform performance of vehicle inspection, the program management must generate the required test specifications and procedures and provide for the necessary orientation and training sessions for test and maintenance personnel. Classes should be conducted at the outset of the program and throughout the program life to accommodate changing personnel, additional facilities and advancing technology.

The Program Manager's office must issue approved test procedures to all participating facilities, continually review the test results, and upgrade and refine the procedures as required to assure uniform and repeatable inspection results and to meet new standards established by the Air Pollution Control Commission and/or the Motor Vehicle Division.

4.5.1 Vehicle Inspection Scheduling Functions

Each vehicle is required to be safety inspected twice in each calendar year at 6 month intervals. The Certificate of Compliance expires on the last day of the sixth month after the month of inspection (Ref. 2).

At the outset of vehicle emission testing, an Inspection Notification form should be distributed to registered vehicle owners. The notification package should include an indoctrination pamphlet that briefly describes the program objectives, emission standards, inspection procedures, recommended maintenance, inspection fee, and other factors necessary to inform and educate the recipient. In addition, the mass communication media should be utilized as appropriate.

Inspection-completion summaries would be prepared by inspection facilities and forwarded to the Program Office. At the Program Manager's office, certification would be confirmed, delinquent vehicles would be identified, and a delinquency list generated and maintained. A delinquency form would be distributed to the registered vehicle owner.

Alternatively, enforcement may be instituted similar to the existing safety inspection program by the removal and/or denial of compliance stickers. All new registration and renewal registration applicants must present proof of compliance.

Present knowledge of vehicle emission profiles as a function of cumulative mileage and/or time does not provide a definite indication as to the desired or opportune inspection interval. The EPA, in its guidelines for air quality implementation plans, acknowledges this deficiency (Ref. 7). Consequently, it suggests a straight-line degradation factor which assumes that post-maintenance emission levels deteriorate to pre-maintenance levels on a linear basis over a 12 month period. As previously noted, the California Air Resources Board currently is conducting an 18 month investigation to resolve questions pertinent to emission degradation. Similarly, the Colorado Air Pollution Control Division presently is investigating emission deterioration for vehicles operating at higher altitudes. Results of these studies may be helpful in establishing the vehicle emission inspection interval.

While it may be convenient to have a vehicle inspected for both safety and emissions compliance during a single visit, existing data does not justify a twice-a-year emissions inspection. In view of the expected increase in the vehicle owner's inspection fee to test for both safety and emission compliance, and the lack of data substantiating increased effectiveness (more emission reductions), it is recommended that emissions be inspected once a year until such time as study results prove conclusively that twice-a-year emission inspections are more cost effective.

4.5.2 Program Indoctrination and Public Relations

The indoctrination and training of inspection personnel should be augmented with a general familiarization program for the total population. Public information generated for communication media should be prepared carefully to explain fully the program objectives and operations. The results of the public opinion surveys described in Section 6 should be helpful in developing such information for release to the general public.

The City of Chicago currently is inspecting vehicles using the Idle test procedures. Preparatory to inspecting the first vehicle, the evaluation and analysis of pertinent factors and considerations were required. This Phase I investigation was conducted for the Chicago Department of Public Works and the Department of Environmental Control (Ref. 11). One of the recommended practices was to distribute brochures designed to educate the motorist. Summarized below are the suggested contents of a brochure as modified to include both safety and emissions inspection.

- Reasons for vehicle safety inspection — Reduce traffic accidents, damage, injuries and fatalities.
- Reasons for vehicle emission inspection — Identify major vehicle emission pollutants and relate to air quality.
- Items to be safety inspected, and method — Brakes, steering, suspension, tires, wheel assemblies, lighting, glazing, exhaust system, undercarriage, and exterior body.
- Emission inspection standards and procedures — List of the emission standards and description of the inspection procedure.

- Corrective maintenance — Identification of probable causes for inspection failure, methods of insuring a well-maintained vehicle for safer operations and lower emissions.

- Reinspection required — Procedures to receive Certificate of Compliance, allotted time, enforcement and penalties.

- Consumer protection plans — Licensed facilities, certified inspectors, posted inspection fees, posted labor rates, procedures for filing complaints.

As the program progresses, the State management office should evaluate inspection data and advise the public of the effectiveness and benefits resulting from the emission and safety inspection program. The public will be more responsive to the implementation program when it is aware of its contributions.

The data collected on safety and emissions-inspected vehicles should be evaluated to identify high incidences of failure, to determine failure trends, to identify failures common to a model year or manufacturer, and to reveal other information that may be used to enhance traffic safety and reduce air pollution. In order to increase program effectiveness in terms of emission reduction and accident prevention, public support and cooperation should be enlisted by making the motorists aware of the problems, the solutions, and their individual roles in each. Toward this end, the collection, analysis, interpretation, and presentation of program data and information are essential.

4.5.3 Inspection Standards

Emission limits are established as a function of vehicle model year in order to accept or reject a fixed percentage of all tested vehicles within a specific test concept to achieve a desired level of emission reduction. These limits necessarily would consider the resultant impact of the applicable air quality standards and strategy. During the course of the statewide implementation, continual evaluation of test results will be necessary in order to assure that the desired effectiveness is being achieved. Any required changes will be reflected in the test procedures.

As newer emission-controlled vehicles enter the market, tighter inspection limits may be required for these vehicles to reflect the stricter federal or State emission standards. Additionally, as retrofit devices and/or vehicle modifications are approved for installation, the applicable emission limits will be modified to reflect the lower allowable levels.

Vehicle safety standards are established for new production vehicles by the U.S. Department of Transportation (DoT). In-use vehicle standards recently were issued by the DoT to be used as guidelines for state programs (Ref. 1). As currently promulgated, the federal standards do not include items covered by the Colorado standards (Ref. 2). When newer federal standards are issued on these remaining items, the Colorado standards should be reviewed and modified as appropriate.

4.5.4 Inspection Equipment

The Program Office should continually maintain cognizance of the current status of test equipment technology to assure that equipment used at the inspection facilities is current and satisfies changing test requirements. As future emission requirements become more stringent and sampling methods are changed, the testing requirement may become correspondingly more precise. These needs should be anticipated by the Program Office.

Current safety inspection standards in Colorado are more extensive than federal requirements. As such, it is doubtful that the equipment required to conduct safety inspections during future years will change much. However, the Program Office should remain aware continuously of new developments in inspection techniques and equipment.

The Program Office should be in a position to recommend removal of obsolete equipment and the substitution of newer, approved units whenever appropriate to maintain the desired level of program effectiveness. Accordingly, the responsible State agency must be appraising continuously all new emissions and safety inspection equipment, updating inspection procedures, and revising equipment certification criteria.

4.5.5 Inspection Personnel

The primary duties of inspection personnel are to: 1) conduct inspections and tests; 2) perform data and information processing tasks; and 3) operate and maintain station equipment and instrumentation. In addition, they would be required to meet with the vehicle owners, discuss test results, and recommend corrective measures.

Training — To assure uniformity in performance and to achieve the desired program objectives, some form of initial and sustaining training program would be required. The schedule may include classroom instruction, laboratory demonstrations, and on-the-job training (OJT).

Training classes could be conducted in existing public education facilities. Laboratory classes could meet in vocational schools equipped with the required equipment, in private independent garages or in new-car dealers' repair shops similarly equipped. On-going OJT necessary to incorporate new inspection procedures and instrumentation would be accomplished most easily at the respective inspection stations.

Qualifications and Certifications — Vehicle safety inspectors must satisfy the requirements specified in the Rules and Regulations of Colorado (Ref. 2). The previous study for Colorado on vehicle emission inspection identified the qualifications and training curriculum for vehicle emissions inspectors (Ref. 5). These may serve as initial guidelines until the proposed Colorado State University training program for inspectors is implemented.

4.6 COST ANALYSIS

For the previous Colorado study of vehicle emission inspection and control (Ref. 5), a detailed cost analysis model was developed that provided a framework for evaluating the program costs associated with each inspection alternative. This model was designed to provide expected aggregate cost magnitudes for the various program areas throughout the desired program lifetime for each alternative considered. Since they will vary both in cost and expected methods of implementation and administration, the cost model did not provide a cost accounting treatment of required program expenditures; it was simply a tool that allowed cost items to be identified and analyzed readily.

Each of the alternative inspection programs evaluated involved an extremely large number of fixed and variable cost items. Personnel wages, building costs, maintenance, and equipment and installation costs were evaluated systematically for each alternative such that the total cost of each inspection concept was assessed.

Life-cycle costing assured that required resources were systematically considered, assisted in the analytical process, facilitated data acquisition and mathematical computation, and indicated areas of critical resource requirements.

The life-cycle cost model categorized cost elements into major sub-models of research and development, acquisition and investment, and operations and maintenance.

The research and development category included all costs necessary to conceive, design, develop, and document a total program capable of satisfying the identified goals and objectives. For each of the program alternatives evaluated, this cost category identified and quantified the expenditures necessary to finalize the concept to the point of implementation. Specific equipment, personnel, facilities, support management procedures, and other considerations were costed to assure complete coverage of resources.

The acquisition and investment category included all the resources and costs to be incurred in the process of initial program implementation. The resource elements included facilities, instrumentation, and manpower and their associated functional elements including certification, indoctrination and initial training. This category included those expenditures that are of a non-research and development and non-recurring nature associated with the initial acquisition and start-up of the program.

The operation-and-maintenance category included all of those expenditures necessary to operate and maintain the inspection facilities, and to manage the overall program. Cost elements included expenses such as personnel wages and salaries, facilities upkeep, sustaining or replacement training, and facility recertification. This category included all recurring expenditures for the total program.

4.6.1 Vehicle Emission Inspection Program Cost

The cost analysis for the Colorado study was directed primarily at comparing program costs for vehicle emission inspection as performed in State-operated and privately-operated, licensed facilities. Listed in Table 4-5 are the cost estimates for a vehicle emission inspection only. See Appendix E for the cost summaries extracted from the previous study (Ref. 5).

The annual inspection fee for emissions testing in a State-operated facility or in a privately-owned, State-licensed facility represents an allocation of an amortized initial investment and annual operation costs. The fees are based on once-a-year inspections. In the previous Colorado study, a labor rate of $12 per hour was used; and equipment was amortized over 5 years to calculate the fee for private garage inspection. In addition, the costs to train the inspectors were absorbed by the garages. Consequently, of the $5.45 estimated previously for Idle emission inspection, the compliance sticker would cost the station operator $0.60 for State management expenses, the direct labor charge would be $2.60 (13 minutes inspection time at $12 per hour), and the station overhead increase would be $2.25 per vehicle inspected (allocated from inspector training and new equipment purchase, maintenance, and operation expenses).

The overhead increase could be reduced as a function of initial investments required by the station operator. For example, it was assumed that at least two inspectors per station would complete the suggested training curriculum. This would involve roughly 80 hours per inspector or 160 hours per station. In addition, the equipment for emission inspection included a combination HC-CO-CO_2 analyzer for $2,650, a sampling system

Table 4-5. PROGRAM COSTS — VEHICLE EMISSIONS INSPECTION[a]

Program Alternative	State Cost	Private Industry Cost	Total Costs	Vehicle Owner Allocated Cost[b]
Initial Investment				
Idle — State Operated	$2,172,000	None	$ 2,172,000	$ 1.67
Privately Operated	298,000	$ 7,513,000	7,811,000	6.00
Key Mode — State Operated	3,333,000	None	3,333,000	2.56
Privately Operated	351,000	15,876,000	16,227,000	12.48
Annual Operation				
Idle — State Operated	2,226,000	None	2,226,000	1.71
Privately Operated	739,000	6,190,000	6,929,000	5.33
Key Mode — State Operated	2,770,000	None	2,770,000	2.13
Privately Operated	909,000	9,536,000	10,445,000	8.03
Annual Inspection Fee				
Idle — State Operated	$2.10	None	$2.10	2.10
Privately Operated	0.60	$4.85	5.45	5.45
Key Mode — State Operated	2.67	None	2.67	2.67
Privately Operated	0.74	8.17	8.91	8.91

[a] Extracted from "Vehicle Emission Inspection and Control Program," Olson Laboratories, Inc., (Ref. 5).

[b] Assumes 1.3 million vehicles as of 1973 registrations.

for \$1,200, an optional NO_2 analyzer for \$2,800 and a frame and assembly to contain the total system for \$500. Due to recent advances in instrumentation and manufacturing, the total system cost of \$7,150 may be reduced to about \$1,500 to \$2,500, without measuring NO_x. Thus by reducing the inspector training requirements and the instrumentation cost, the overhead cost increase may be lowered. The result would be a lowering in the inspection fee charged the motorist to about \$4 per inspection (\$2.60 labor plus \$.80 overhead plus \$0.60 State management).

4.6.2 Integrated Safety-Emission Inspection Program Cost

The previous discussions have addressed the question of how much vehicle emissions inspection would cost in State and privately operated facilities. Earlier, the cost was estimated for inspecting safety-related vehicle components in existing licensed inspection stations. A logical extension to the investigation is to determine the approximate cost to perform both safety and emissions inspection in State-operated facilities and licensed private stations.

Appendix F includes the analysis of the costs associated with an integrated safety-emissions inspection program. For the State-operated facilities, the cost analysis deals primarily with the construction and operation of new facilities. Thus the concern is with the relative magnitude of program cost elements. However for inspection in private stations, the emphasis is with differential cost. That is, since safety inspection currently is being performed in these facilities, then the concern is with the additional cost incurred to provide emission inspection in conjunction with safety inspection.

Tabel 4-6 shows the cost analysis summary of a program involving both safety and emissions inspection. The analysis assumes that all of the 4,200 privately-operated, safety inspection stations

Table 4-6. PROGRAM COSTS — VEHICLE EMISSIONS AND SAFETY INSPECTION[a]

Program Alternative	State Cost	Private Industry Cost	Total Costs	Vehicle Owner Allocated Costs
Initial Investment				
State Operated	$11,043,000	None	$11,043,000	$ 8.49[b]
Privately Operated	None	$14,868,000	14,868,000	11.44[b]
Annual Operation				
State Operated	9,848,000	None	9,848,000	7.58[b]
Privately Operated	1,723,000	3,318,000	5,041,000	3.88[b]
Annual Inspection Fee				
State Operated	$8.30	None	$8.30	8.30[c]
Privately Operated	1.33	$4.40	5.73	5.73[d]
Semi-Annual Inspection Fee				
State Operated	4.15	None	4.15	4.15[c]
Privately Operated	0.67	4.40	5.07	5.07[d]

[a] See Appendix F, Integrated Safety-Emissions Program Cost.

[b] Assume 1.3 million registered passenger vehicles.

[c] Includes amortized initial investment cost at 6 percent over 20 years.

[d] Equipment cost amortized over 5 years, personnel training over 3 years.

would be upgraded to perform Idle emission inspections. For the State-operated alternative, 66 new fixed-site facilities would be constructued, equipped, and staffed. In addition, 23 mobile units would be purchased. The vehicle-owner-allocated costs are shown for comparative purposes only. The vehicle-owner inspection fees assume that the initial investments for the State would be amortized; thus, the annual operating cost shown in the table is increased by the uniform annual payments on the investments. Conversely, for the privately-operated stations, the equipment purchase price is amortized over 5 years, while the personnel training costs are amortized over 3 years, an employment period assumed to be typical for mechanics.

For annual inspection, the privately-operated stations would charge less than the State. However, for semi-annual inspections, the State would charge less. The primary reason is that with more frequent inspections, the fixed capability of State facilities is utilized efficiently. With privately-operated stations, the fee is established on labor and overhead; and increasing the frequency of inspection would not decrease the inspection fee, other than the allocated State management expenses, which would be halved.

The direct cost difference to the vehicle owner is $0.92 per visit on a semi-annual basis. However, factors such as owner convenience, distance travelled, and confidence in test results must be assessed to select one alternative over the other. For example, there would be only 66 fixed State-operated stations. This disparity is somewhat diminished by the 23 mobile units operated by the State. Relative to working hours, the private stations would have longer operating hours and more working days compared with State facilities.

SECTION 5

PUBLIC OPINION SURVEYS

This Section reviews and summarizes three public opinion surveys conducted in Colorado during 1972. These surveys were designed to ascertain public response to questions concerned with air pollution in general and motor vehicle emission reduction in particular.

Public attitudes and sentiments on specific issues are presented to facilitate policy decisions. Areas requiring public indoctrination to alleviate misunderstandings or to allay unfounded fears are identified. Topics requiring further investigations to better define public response are also included.

5.1 SURVEY DESCRIPTIONS

Three recent public opinion surveys conducted in Colorado were reviewed for this report. These surveys are described below:

- Northrop Corporation/Olson Laboratories, Inc. — Survey performed as part of a study for the Colorado Department of Health in September 1972. Opinion Research of California designed the questionnaire, selected the sample size (267 rural residents, 450 urban residents), conducted the interviews by telephone and in house, compiled the data, analyzed and interpreted the results (Ref. 5).

- TRW Report — Survey performed for the EPA, Region VIII, Denver, in 1972. Consumer Mail Panels of Chicago selected the sample from the residents of the Denver-metropolitan area to be representative of the area in terms of income level and age. Data analysis is based on 204 replies (Ref. 12).

- Alire and Clark Report — Survey performed as a part of a student research paper presented to Dr. R. Beatty, University of Colorado in Boulder. The survey was completed in 1972 and involved a sample of 100 respondents selected on a non-random basis from the Denver Metropolitan Telephone Directory (Ref. 13).

The Colorado Air Pollution Control Division also provided a copy of a study performed by Stanley Jones, Institute of Behavioral Science, University of Colorado. This report, "Public Response to Air Pollution in the Denver Area," did not involve any public interviewing (Ref. 4). It is a review of other surveys conducted, including the three identified earlier. Accordingly, that study does not provide additional information on Colorado residents. However, the study does identify areas warranting further research. These, along with others, will be discussed in subsequent paragraphs at the conclusion of this section.

5.1.1 Demographic Considerations

Table 5-1 lists the characteristics of the survey sample for each of the three reports being considered. It is recognized that sample selection procedures differ according to project objectives and economic and schedule constraints. However, it is interesting to note that similarity in sample characteristics occurs in spite of these differences.

Table 5-1. DEMOGRAPHIC CHARACTERISTICS

Characteristics	Northrop and ORC	TRW and CMP	Alire and Clark
Sample Size	717	204	100
		(Percent)	
Male Respondents	44	Not Determined	54
Female Respondents	56	Not Determined	46
Education		Not Determined	Not Determined
12 years	22		
High School Graduate	29		
Some College	27		
College Graduate	14		
Post College	7		
Family Income			
<$5,000	13.7	35	Not Determined
$ 5,000 to $ 8,000	15.9		
$ 8,000 to $10,000	18.9	46	
$10,000 to $15,000	24.5		
>$15,000	23.3	19	
Unknown	4.6		
Vehicles Owned			
0	--	2	
1	30	30	
2	48	50	All Respondents Owned At Least One Vehicle
3	14	18	
4	5		
5	1		
>5	2		

5.2 OPINIONS ON AIR POLLUTION

Colorado residents were queried as to their perception of the seriousness of the air pollution problem, their awareness of the major contributors to the problem, and their appraisal of efforts to control or eliminate the problem. Each survey addressed these areas in a differing manner, as noted below.

5.2.1 The Extent of Air Pollution

Both the TRW and the Alire-Clark (AC) reports concentrated their sampling in the Denver-metropolitan area. Of the AC sample, only one respondent felt that Denver does not have an air pollution problem. Of those stating that a problem exists, 46 percent judge it to be extremely serious; and 53 percent, moderately serious. Similarly, in the TRW report, 39 percent of the respondents think the Denver air pollution problem is very serious; 30 percent, serious; and another 24 percent, slightly serious. Due to the different scaling or weighting of the responses, a definite percentage cannot be determined from these two reports. However, it may be concluded that over 39 percent of the Denver-area residents feel that the City's air pollution problem is very serious, with another 53 percent believing the problem to be serious or slightly serious.

The Northrop/Olson survey conducted by Opinion Research of California (ORC) sampled the total State. In this survey, 61 percent of the sample feel that air pollution is a very serious problem; and 34 percent, somewhat serious. On an area-wide basis, 55 percent of the rural residents feel that the problem is very serious compared with 62 percent of the urban residents.

5.2.2 Causes of Air Pollution

The ORC survey attempted to determine the residents' awareness of the causes for air pollution. Respondents were asked to identify the major cause for the Colorado air pollution problem. Within the urban sector, 75 percent believe automobiles are the major cause whereas 61 percent of rural respondents suggested this. Of the total respondents, 29 percent thought the factories and industry are the major cause, 8 percent felt that trucks are responsible, and 19 percent suggested other sources such as aircraft, public service plants, buses, and steel and saw mills.

The other two surveys did not question the respondents on the causes for air pollution in Colorado. Therefore, no comparisons of responses can be made between the surveys on this subject.

5.2.3 Efforts to Control Air Pollution

The Denver-area respondents in the AC study were almost unanimously (95 percent) in favor of increased efforts to control air pollution. Of those in favor, 54 percent felt the increase should be great, 27 percent felt the increase should be moderate, 4 percent thought a slight increase would be sufficient, and 5 percent were uncertain as to the degree of increased effort required.

The Northrop-ORC survey question was directed toward determining the respondents' perception of the past and present role of governmental effort in controlling air pollution. Although structured differently from the AC survey question, the responses may be compared. For the ORC survey, 13 percent believed a great deal of effort was being expended, 40 percent believed some effort was being expended, and 38 percent claimed not enough effort was being expended.

The ORC report noted that respondents who think air pollution is a very serious problem are likely to have a less favorable image of government efforts to control air pollution than are respondents who evince less concern with the problem. This is evident in that whereas 38 percent of all ORC survey respondents (total State) felt not enough effort was being expended, the AC survey showed that at least 58 percent felt greater effort should be expended (all Denver-area respondents).

The TRW survey did not include this subject in its questionnaire.

5.3 OPINIONS ON VEHICLE EMISSION CONTROL STRATEGIES

"The State of Colorado Air Pollution Control Transportation and Land Use Plan" was submitted to the Region VIII Office of the EPA on May 25, 1973 (Ref. 15). As prepared by the Colorado Department of Health, the plan outlines the various strategies to be pursued by the State to meet the established Federal Ambient Air Quality Standards by May 31, 1975.

Basically, the implementation plan calls for two categories of control measures, primary and secondary. These measures, as extracted from the Plan, are listed in Table 5-2. With the exception of a few specific alternatives applying to heavy-duty vehicles and fleet operators, the control measures will affect the majority of the owners of light-duty passenger vehicles. Accordingly, the discussions to follow address those control measures that were included in the public opinion surveys. The analysis may indicate the likelihood of public acceptance for the control measures proposed for implementation, along with the expected success of public participation as definable from the survey results.

Table 5-2. CONTROL MEASURES TO ACHIEVE FEDERAL AMBIENT AIR QUALITY STANDARDS[a]

Primary Stage Control Measure
1. Citizen participation
2. Vehicle turnover
3. Improved mass transit
4. Provide "Bikeways"
5. Vehicle inspection and maintenance
6. Vehicle retrofit
7. Vehicle high altitude modifications
8. Reduction of hydrocarbron evaporation losses
9. Fleet vehicle gaseous conversion
10. Gasoline rationing
11. Mechanic training

Secondary Stage Control Measure
1. Staggered work hours
2. Four-day work week
3. Idle traffic control
4. Traffic-free zones
5. Establish car pooling locator service
6. Restoration of commuter rail service
7. Implement a "horsepower" tax
8. Bus maintenance and inspection
9. AQCR gas tax for use as transit funding base
10. Gaseous conversion of all public conveyances (common carriers)
11. Heavy duty vehicle retrofit
12. Heavy duty vehicle inspection and maintenance
13. Develop peripheral parking facilities in conjunction with transit system
14. Exclusive bus lanes established
15. Establish limited use license plates by color coding
16. Through movement only streets
17. Strict enforcement of existing parking and traffic regulations, bans on taxi cruising and special traffic flow considerations at construction sites
18. Selective restriction on vehicle use during designated months, alternate usage of public streets by last digit of license (odd or even)

[a] Extracted from "The State of Colorado Air Pollution Control Transportation and Land Use Plan," May 25, 1973.

5.3.1 Citizen Participation

To achieve expected effectiveness in an emission reduction strategy involving the vehicle owner, an active participation of citizens may be achieved through the development of citizen awareness and understanding of air quality and transportation problems. Earlier discussions have noted that Colorado residents in general and Denver-area residents in particular are quite aware of the existent air pollution problem. Additionally, the large majority identify the automobile as the major cause of this problem. However, it has been shown that public acceptance of a control strategy decreases with direct costs (money, time, inconvenience, etc.) to the citizen. These costs will be described in specifics as they apply to particular strategies.

The citizen participation control measure will require a coordinated program of public information and education to solicit and develop the necessary public response. Material for this program may be extracted from these studies and other related reports. Suggested topics are included at the end of this section.

5.3.2 Vehicle Turnover

This emission control strategy is dependent on newer and cleaner vehicles replacing the older vehicles due to normal attrition. Thus, as the future vehicle population mix trends toward a larger proportion of post-1968 vehicles, the total exhaust emissions levels contributed by these vehicles become less. None of the surveys being considered herein included questions relative to whether current owners would continue to replace their aging vehicles with newer models. The affects of the current gasoline shortage and proposed restrictions on vehicle speed limits and parking, coupled with the relatively poor performance of newer vehicles, need to be considered.

5.3.3 Improved Mass Transit

Total passenger vehicle miles traveled may be reduced with a resultant decrease in emissions by providing an alternative transportation mode in the form of mass transit. The AC survey of Denver-area residents indicated that 79 percent would favor taking the bus downtown, with 45 percent strongly favoring this form of transportation. However, it was noted that of the group who drove downtown frequently, 40 percent were opposed, with 27 percent strongly opposed to mass transit. For the infrequent City visitor, 16 percent opposed taking the bus. When this survey sample was asked if they would be willing to pay tax increases of $25 to $50 per year to provide new transportation methods in the Denver area, 54 percent responded favorably, 34 percent unfavorably.

The TRW study involving Denver-area residents attempted to determine current utilization of mass transportation systems. Results indicated that 87 percent of the husbands never used these transit systems, 77 percent of the wives never used them, and more than 90 percent of the children over 16 years old have never used these public transportation systems. Respondents indicated that one of the main reasons for driving was lack of mass transit close to their residence. When asked to rank the methods of encouraging the use of public transportation, the methods receiving the highest ranking were: 1) more frequent service; 2) more conveniently located stops and stations; 3) faster travel; 4) parking facilities at stops and stations; and 5) lower fares.

The Northrop-ORC surey was not structured to evaluate mass transit opinions.

5.3.4 Provide "Bike Ways"

Another method of reducing passenger vehicle miles traveled is to promote the increased utilization of bicycles as a mode of transportation. None of the surveys being reviewed addressed this emission control measure.

5.3.5 Vehicle Inspection and Maintenance

The AC survey of Denver-area residents included one question relative to this control strategy. Respondents were asked if they would favor or oppose vehicle exhaust inspection twice a year. Seventy-one (71) percent would strongly favor this proposition with another 20 percent moderately in favor. Similarly, the TRW survey of Denver-area residents established that 59 percent would be very much in favor of periodic inspection, with 26 percent somewhat in favor. On a statewide sample basis, the Northrop-ORC study showed that 50 percent would strongly favor mandatory emission inspection and 31 percent would be somewhat in favor. This survey showed that on a residential basis, 42 percent of rural residents would strongly favor an inspection program compared with 52 percent or urban residents. An additional 34 percent of rural residents would somewhat favor the program compared with 30 percent of the urban residents. It can be concluded that roughly 75 percent would favor a mandatory inspection program.

Inspection Cost - The TRW study determined that 29 percent of the respondents felt a reasonable inspection cost would be $2, 21 percent thought $5 was reasonable, whereas 10 percent favored $1. For the Northrop-ORC study 12 percent of the respondents believed it should be $1 or less, 34 percent thought it should be $1.50 to $2, 8 percent felt it should be $2 to $3, and 9 percent thought it should be $3 to $5. The AC survey did not ascertain expected inspection cost. It appears that an inspection fee of $2 or less would receive the highest favorable response. If the fee imposed is about $1, 50 percent would approve. If the fee charged is about $2, then 30 percent of the respondents would approve.

Inspection Station Operator — The TRW study showed that if inspection were required, 36 percent of Denver-area residents would prefer State-operated facilities, 8 percent would prefer City-operated facilities, and 53 percent would favor service stations or garages. Grouping State-operated and City-operated facilities, then 43 percent would prefer government-operated facilities compared with 53 percent favoring local service stations and garages. In contrast, the Northrop-ORC survey of the total State indicated that 42 percent would prefer State operation and 49 percent would prefer private garages. (There were no city-operated stations offered as an option for this study.) Analyzing the data on a regional basis, in AQCR Number 2 representing Metropolitan Denver, the responses were 45 percent for State operation compared with 44 percent for private garages. Relative to residence, the ORC survey showed that rural residents definitely favor private garages (56 percent) over State facilities (34 percent), whereas urban residents are relatively divided, with 47 percent favoring private garages and 44 percent for State operation. On the basis of the TRW study and ORC study, it cannot be concluded as to which the urban residents would favor. However, it appears that the rural residents would prefer inspection by local service facilities. The AC study did not address this question.

Inspection Period — The AC study showed that Denver-area respondents strongly favor twice-a-year inspection (71 percent). However, the survey did not attempt to establish what inspection period would be preferable since that was the only question asked relative to periodic inspection. In a similar vein, the

TRW study asked questions relative to annual vehicle inspection, but no questions were included to determine periods preferred. The Northrop-ORC study showed that 59 percent of the respondents would prefer twice-a-year inspection and 27 percent would favor once-a-year.

Other Factors Related to Inspection and Maintenance — Many other factors must be considered in the implementation of an inspection and maintenance program. Factors such as driving distance to facilities, vehicle owner maintenance costs, and program compliance and penalties all affect public acceptability of proposed control measures. Because the Northrop-ORC survey was the only study structured to determine public opinion of these specific items, no comparative analysis can be performed. However, these considerations are of significant importance to the proposed emission control strategies, and as such are summarized below:

- Driving distance to inspection station — A driving distance of 5 miles or less was preferred by 47 percent of the urban residents; whereas, 44 percent of the rural residents thought 10 miles or less would be reasonable. In general, the rural residents will be more tolerant to longer driving distances such as 15 to 20 miles.

- Emission-oriented maintenance — Of the respondents surveyed, 61 percent claimed that their vehicle's emission control devices were never checked. Respondents, in general, did not know how much a tune-up should cost. The largest response (12 percent) believed the cost should be between $20 to $30. The estimates ranged from $10 to $100, with 35 percent of the respondents unable to offer a cost figure.

Not surprisingly, when respondents were asked what they believed would be the maintenance cost to meet emission inspection limits, 78 percent did not know what a realistic amount should be to correct vehicle failure. At least 60 percent agreed that it would be reasonable to be required to spend $50 to $150 every 2 to 3 years to pass vehicle emission inspection.

- Inspection compliance — Respondents were asked to identify methods of paying for necessary vehicle repairs to attain inspection compliance. The most frequent responses were that failed vehicles should be kept off the road until repaired (30 percent) and that State or other governmental financial aid should be provided (28 percent). However, when asked whether the State should pay for all costs for those unable to pay repair charges, 54 percent said the State should not, whereas 43 percent agreed. If financial assistance is not provided, 66 percent said the vehicle should be banned from highway use until repaired, while 9 percent thought these vehicles should be exempted.

- Enforcement penalties — For violating the program requirements, 32 percent of the interviewees believed a monetary fine should be imposed ranging from $5 to $50. Another 18 percent thought a warning coupled with a monetary fine, suspended driver's license, license plate removal, or car removal from the highway would be warranted. Other penalities suggested included non-renewal of registration, judicial decision, and deduction of points from driver's license.

__Factors Related to Safety Inspection__ — Several questions related specifically to vehicle safety inspection also were asked to establish its public acceptability and to identify areas that may require modification. These questions are summarized below:

- Approval of current safety program — Almost all respondents (94 percent) indicated an approval of the existing program, with 79 percent expressing strong approval.

- Safety inspection period — The overwhelming majority, 84 percent, believe that safety inspection should be performed twice a year as compared with 15 percent favoring once-a-year inspection.

- Safety inspection cost — The opinions were relatively divided as to whether the motorist would be willing to pay $5 to $7 annually to assure a more thorough inspection and better enforcement. As a group, 50.6 percent were in favor and 47.4 percent were opposed.

- Inspections by State or private station — The large majority, 71 percent, believe the private sector should continue the safety inspections rather than the State.

- Distance traveled to safety inspection station — The vast majority of urban residents (78 percent) travel less than 5 miles to have their vehicles inspected. For the rural residents, approximately 57 percent travel 5 miles or less.

5.3.6 Vehicle Retrofit

The AC study showed that vehicle owner interest in reducing pollution from cars decreased with increasing owner cost. Of the respondents surveyed, 95 percent were in favor of $10-per-year costs incurred for changes made to their car to effect lower pollution. This favorable response decreased to 74 percent when the costs were $20 per year, and decreased further to 53 percent with costs of $50 per year. The report does not indicate what these changes to the vehicles would be nor what the costs are for on an annual basis. However, the results are discussed here because any changes made to vehicles after they are manufactured become retrofit systems by definition.

The TRW survey asked the respondents whether they would favor a law requiring retrofitting vehicles with emission control equipment costing $200 per car: 10 percent were very much in favor, 21 percent were somewhat in favor, 15 percent somewhat against, and 54 percent strongly against. However, if the cost were reduced to $50 per car, 50 percent would strongly favor the law, 23 percent would be somewhat in favor, 11 percent would be somewhat opposed, and 15 percent still strongly opposed.

The Northrop-ORC study did not include a specific question on retrofit system installation. However, the respondents were queried as to whether all vehicles, regardless of age, should be required to have emission control devices installed. In response, 41 percent strongly agreed, 24 percent tended to agree, 17 percent tended to disagree, and 14 percent strongly disagreed with mandatory installation of emission control devices.

From the results of the three surveys, it may be concluded that vehicle retrofit systems are acceptable to the public as a means of emission control. The degree of public acceptance will be highly dependent on the vehicle owner costs. However, other factors such as vehicle performance, driveability, and fuel economy as affected by the retrofit systems were not addressed in the questionnaires and will undoubtedly influence public acceptance.

5.3.7 Vehicle High-Altitude Modifications

These vehicle modifications directed toward increasing fuel consumption efficiency at high altitude would be installed on a retrofit basis, similar to that described earlier. No further discussion of public opinion is provided on this issue. However, if included as part of a survey, the public response to this type of vehicle modification would most likely be highly favorable in view of the expected installation cost of $20 to $35, the increased fuel consumption efficiency, and the improved vehicle performance (Ref. 15).

5.3.8 Gasoline Rationing

Vehicle emissions may be decreased directly by limiting gasoline availability. The direct reduction of vehicle miles traveled may have severe socio-economic impact on the public. The TRW survey of Denver-metropolitan-area residents indicated that 71 percent find gasoline rationing to be very unacceptable with another 1 percent finding it somewhat unacceptable. Neither the AC study nor the Northrop-GRC study addressed this method of emission reduction.

5.3.9 Staggered Work Hours

As a means toward relieving traffic congestion, staggered working hours have been considered. The TRW study results indicate that 33 percent were very much in favor of such a plan, 31 percent somewhat in favor, 16 percent were indifferent, 12 percent were somewhat opposed, and 8 percent very much opposed.

Like the TRW study, the AC study sampled only Denver-area residents, thus providing a direct comparison. In their study, the AC team noted that 9 of 15 (60 percent) who worked in downtown Denver would strongly favor staggered work hours with another 3 moderately favoring the idea. Since only 15 of the 100 AC respondents worked in the downtown area and consequently would be directly affected by staggered work hours, the AC study noted that their results must be termed inconclusive. The Northrop-ORC study was not developed to address this issue.

Based on the limited sample response of the AC study, and augmented with the larger sample size of the TRW study, it may be concluded that the majority of Denver-area residents would be receptive to staggered working hours as a method of reducing vehicle emissions.

5.3.10 Passenger Vehicles Traffic Reduction

The AC study determined that 50 percent of Denver-area residents would strongly favor reducing downtown traffic as a way of reducing pollution with another 16 percent somewhat in favor. If a cost of $5 was incurred for each trip to the downtown area, then 44 percent would be strongly opposed with 13 percent somewhat opposed.

Passenger vehicle traffic into the central business district (CBD) may be curtailed by imposing tolls on exit ramps of major freeways and expressways. The TRW study showed that 39 percent of Denver-area residents thought this very unacceptable with 19 percent finding it to be somewhat unacceptable. Their attitudes would not change if the tolls were imposed only during heavy traffic.

Other methods of reducing passenger vehicle traffic are to prohibit traffic and parking or to impose parking taxes in the CBD. According to the TRW study, at least 63 percent of the Denver-area residents would favor prohibiting traffic and parking in the CBD; 33 percent of the respondents thought this was very acceptable and the other 30 percent somewhat acceptable. If a tax were imposed for all-day parking in the CBD, the respondents were divided with 45 percent believing it to be acceptable. A large proportion of the respondents, however, found it to be very unacceptable (30 percent). If the taxes were collected for CBD parking regardless of the duration (1 hour or all day) then 42 percent of the respondents found this very unacceptable and 18 percent somewhat unacceptable.

The TRW study indicated that the restriction of non-essential automobile travel during periods of high air pollution would be somewhat unacceptable. If special license plates or vehicle stickers were necessary to implement this type of emission control, 37 percent would find this very unacceptable and 12 percent somewhat unacceptable. Conversely, 13 percent believe this method to be very acceptable and 28 percent somewhat acceptable.

5.3.11 Car Pools

The TRW survey of Denver-metropolitan residents indicated that 6 percent travel to and from work in a car pool, 19 percent are very interested in the idea, 31 percent somewhat interested, 33 percent not at all interested and 11 percent do not travel to and from work by car. When the sample respondents were asked how difficult it would be to get into a car pool if necessary to reduce vehicle traffic, 31 percent said it would be extremely difficult, 11 percent said very difficult, and 20 percent said somewhat difficult. At least 23 percent said it would be easy to get into a car pool.

5.3.12 Increasing Traffic Flow

Decreasing the amount of vehicle operating time will result in a corresponding decrease in vehicle emissions. In addition, since emission levels are typically higher at lower operating speeds, then an effective method is to increase the movement of CBD traffic.

Freeways, Expressways, and Major Arterials — The TRW study determined that 62 percent would favor converting some of the existing lanes of major expressways and streets into "bus only" and "car pool only" lanes. Slightly more than one-third (35 percent) thought the concept very acceptable and 27 percent somewhat acceptable.

The AC survey of Denver residents indicated a definite opposition to building more freeways in the Denver area. Of the 56 percent in opposition, 2 percent were slightly opposed, 19 percent moderately opposed, 35 percent were strongly opposed, and 10 percent undecided. Support for more freeways was expressed by 34 percent of the respondents.

Traffic Control — The AC survey showed that residents are opposed to increasing the traffic speed on major Denver streets: 5 percent were slightly opposed, 16 percent moderately opposed, 43 percent strongly opposed, 12 percent undecided, and, to some degree, 23 percent were in favor of increasing traffic speed.

The TRW survey included other methods of effecting better traffic movement. These control measures are listed in Table 5-3. Neither the AC survey nor the Northrop-CRC survey included questions of this nature, thus no comparable data are available.

Table 5-3. TRAFFIC CONTROL CONCEPTS[a]

	Public Opinion (Percent)			
	Very Effective	Somewhat Effective	Not Effective	Would Increase Congestion
Prohibit parking, loading and unloading on busy streets	49	43	6	2
Increase the number of one-way streets	28	54	17	1
Establish reversible lanes on busy streets to be used during rush hours	20	43	17	20
Prohibit turns at busy intersections during rush hours	38	34	18	9
Widen major streets	40	38	18	5
Widen major streets at intersections only	7	44	35	14
Provide pedestrian underpasses and/or overpasses	43	38	18	1
Improve timing of traffic signals	68	28	5	0
Increase the number and frequency of radio traffic reports	13	60	26	2

[a] Extracted from TRW Study (Ref. 12).

The public believes that improving the timing of traffic signals would be very effective in increasing traffic flow. Another widely acceptable concept would be prohibiting the parking, loading, and unloading of vehicles on busy streets. The public appears to support the concept that providing pedestrian underpasses and/or overpasses would also be effective in removing another source of traffic impediment.

5.4 FUTURE PUBLIC INDOCTRINATION REQUIREMENTS

The Colorado implementation plan to achieve the 1975 ambient air quality standards "calls for a significant change in attitude and life style on the part of most residents of the Metropolitan Region" (Ref. 15). To realize the expected effectiveness of the plan, a coordinated program of public information and education would be essential. The survey results described previously will provide some of the topics for this indoctrination program. Other subjects need to be further evaluated prior to inclusion in an information program. Listed below are topics to be considered for a public information and education program.

- Definition of air pollution — Define the elements contributing to air pollution.
- Damage caused by air pollution — Describe the effects of each air pollution element.
- Contributors to air pollution — Identify types of mobile and stationary sources.
- Passenger vehicle contribution — Define proportion of total atmospheric HC, CO, NO_x, SO, lead and particulates.

- Sources of vehicle emission — Identify major sources of vehicle emissions with corresponding proportions.

- Vehicle emission controls — Identify types of controls installed and initial year of implementation.

- Emission levels of uncontrolled and controlled vehicles — Identify the differences as a function of model year.

- Emission levels as a function of vehicle operation — Describe emissions during idle, low cruise, high cruise, hot soak, and diurnals.

- Emission levels as a function of periodic maintenance — Describe the effects of proper maintenance on vehicle emissions.

- Vehicle owner costs — Describe typical periodic maintenance activities and associated costs; describe typical costs to own and operate a passenger vehicle.

- Vehicle retrofit systems — Describe reasons for retrofit systems, the effectiveness in emission control, the effects of vehicle performance and fuel economy, the cost for installed systems, the maintenance requirements.

- Efforts to control vehicle emission — Describe present and future control measures implemented by manufacturers, government agencies.

- Information sources and availability – Identify the State of Colorado departments from which further information can be obtained; identify the federal sources of publications, and manufacturers and organizations involved in reducing vehicular emissions.

5.4.1 Public Information and Dissemination

The information and education program may be organized by the Public Information Officers of the Departments of Health and Revenue. News releases to local newspapers throughout the State would be the least costly method of reaching the majority of vehicle owners. Periodic interviews by newspapers of responsible departmental directors and supervisors within the Health and Revenue departments should go into greater detail on the implementation plans for vehicle inspection, engine modifications and retrofitting.

Lectures presented by these responsible individuals to various special interest groups will assist in informing those who have concern with the environment and who have influence on their peers. These groups include energy conservation, environmental and ecology groups, Audubon Society, Historical Society, and League of Women Voters. Additionally, meetings of this type usually are covered by the newspapers. Radio and television announcements are costly unless included as part of the news coverage. Special movie films developed for loans to academic institutions and previously mentioned special interest groups may be costly as far as initial investment in time, effort, and materials are concerned. However, the films may be duplicated for wide dissemination without recurring expenditures.

A private consulting firm specializing in public information programs and/or advertising may be contracted with to provide assistance and guidance. The contractor may be employed to work with the appropriate state departments and agencies to devise an overall plan which the State itself would follow. The overall plan would include (1) definition of information program objectives; (2) identification of the communication media to be used; (3) allocation of subject matters discussed as a function of each medium; (4) allocation of budget for each medium; (5) responsible state agency for interfacing with each medium; (6) selection of individuals to be responsible for discussing each subject matter; (7) identification of special interest groups and individual contacts; and (8) development of master schedule and milestones.

5.5 FURTHER INVESTIGATIONS REQUIRED

The effectiveness of the Colorado 1975 Implementation Plan is highly dependent on the cooperation, support and active participation of the vehicle owners and users. Without their support and compliance, the State's goals of achieving the desired air quality standards by 1975 will not be met. The public information and education program designed to communicate the objectives of the implementation program and the roles of residents will do much to assure the success of the plan.

Assuming this public information program is initiated in the immediate future, then further opinion surveys may be directed toward ascertaining the effectiveness of the education program, defining areas requiring further presentations via mass communication medias, and determining whether the public's views on specific issues (e.g., mass transit, limited access to the CBD, retrofit systems, inspection and maintenance) have changed as a result of the public information program.

5.5.1 Opinions of Business and Community Leaders

A survey should be made of business leaders, community leaders, educational institutions, special interest groups (environmental protection, energy conservation, Audubon Society, historical societies), legislators, and others to determine their level of concern with air pollution, methods to improve the CBD, the effects on local businesses as a function of proposed emission control measures, the evaluation of past efforts to reduce and control vehicle emissions, the likelihood of enacting specific control programs, and their estimate of public acceptance of these measures. Because of their relative position in the socio-economic structure of the society, these individuals will be influential in modifying and/or expressing the attitudes of their peers.

5.5.2 Vehicle Purchasing Trends

Several questions remain to be resolved relative to the emission control measures considered. As future vehicles are designed and manufactured to meet the increasingly stringent emission standards, vehicle owner's desires to own and operate these newer vehicles may decrease correspondingly. Initial purchase prices will increase as a result of federally-mandated emission control systems; fuel consumption economy may deteriorate further if the current trend established since exhaust controls were instituted continues; and vehicle performance and driveability may continue to be relatively poor because of the added controls implemented to meet the emission standards. To satisfy manufacturer's warranty, various engine and emission control systems maintenance activities must be performed. With the expected price escalation in labor rates and replacement parts, future new-car owners may anticipate much higher ownership costs. These costs and performance factors may strongly influence future vehicle purchases. Future opinion surveys should attempt to determine the current purchasing policies of passenger vehicle owners along with the expected future policies as affected by increased initial costs due to emission control, probable lower fuel economy, probable poorer performance and driveability, higher maintenance costs, and limited fuel availability.

5.5.3 Retrofit System Installation

A control measure currently being investigated by the State of Colorado is vehicle emission control retrofit systems. While the surveys analyzed herein indicated favorable response to this option, no questions were included to determine public acceptance if, along with emission reduction, the vehicle owner may expect degraded vehicle performance and/or poorer fuel economy, as well as vehicle inspection to assure satisfactory operation. Questions of this type need to be included in a future survey.

5.5.4 Increased Bicycle Utilization

None of the questionnaires reviewed included questions on providing bikeways as a means of decreasing vehicle miles traveled. While more and improved bikeways may encourage increased utilization of bicycles, the question remains whether current vehicle users will ride their bicycles to work and to the stores in lieu of motorized transportation. A future survey will be required to determine public attitudes to better bikeways if increased taxes are involved and if vehicle pollution is reduced by only 1 percent (Ref.15) due to increased utilization of bicycles.

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SECTION 6

VEHICLE OWNER CONSIDERATIONS

This section presents various factors that need to be considered to assure public acceptability, to preclude unnecessary owner expenses, to protect the owner against unfair practices, to provide the process for requesting and granting of waivers, and to provide the process for filing complaints involving malpractice. Each of these factors is directed toward promoting consumer cooperation and insuring consumer protection.

The discussions are not directed toward the specific assignment of responsibilities to either the Department of Health or Revenue. Neither are they directed toward the creation of a new agency in the State or the generation of additional responsibilities within the Department of Law, Office of Consumer Affairs. As described herein, the vehicle-owner considerations are items that may require new legislation and additional departmental responsibilities to assure an effective, viable, and publicly acceptable emission control strategy.

6.1 PUBLIC INFORMATION DISSEMINATION

Initially, the public should be informed of the program objectives, reasons for vehicle safety and emissions inspection, estimated costs for typical repairs, owner options in obtaining vehicle maintenance, and non-compliance penalties (see Section 5). Vehicle owners should be advised of licensed stations and certified inspectors, posted labor rates, complaint procedures, and request-for-waiver procedures. Each of these items are discussed further in the following paragraphs.

Public information should be disseminated periodically via communications media to advise owners of program effectiveness and cases involving unfair practices and their disposition. Program effectiveness data should reflect failure rates and trends.

6.2 LICENSED STATIONS

The current practices of the Motor Vehicle Division in qualifying and licensing inspection stations should be continued. Additional qualifications for Idle emission testing and servicing should be developed and imposed. The Rules, Regulations and Requirements for Motor Vehicle Official Inspection Stations (Ref. 2) should be revised to include emission inspection.

Licensed stations currently display a safety inspection sign for public information. New or modified signs should be provided when emission inspection becomes mandatory.

6.2.1 State Certification

In order to promote program effectiveness and assure uniform inspection quality, the Departments of Health and Revenue should require quarterly appraisal of all licensed stations. The cost estimates for State program administration and management, discussed in Section 4, include the expected expenditures for teams of State certification inspectors whose sole responsibilities are: (1) to re-certify each licensed station four times a year, once every three months; and (2) to investigate complaints filed by the public.

Additional tasks would be for the teams to sell to the station the required compliance stickers for motorists, to collect the inspection data compiled by the station, to resolve any problems the station may have experienced, and to investigate and evaluate observed or reported irregularities.

6.2.2 Posted Signs and Labor Rates

Licensed stations should display the Official Inspection sign in a location that is easily visible to an approaching motorist. The inspection license should be displayed prominently in the office area.

Typical labor rates for safety inspection and/or emissions inspection should be displayed. Also, labor rates for typical vehicle maintenance should be prominently displayed. These would include brake adjustment, full brake replacement (four wheels - disc or drum), partial replacement (front wheel or back wheel), headlight alignment, wheel alignment, light bulb replacement, engine idle speed adjust, carburetor adjustment, ignition timing adjustment, and others. Recognizing that parts replacement, such as for the air filter, would involve a range of values for the part, it is recommended that either the typical range be displayed or only labor charges be shown, with parts charges noted as additional.

If licensed and/or certified station inspectors are required to to be specially qualified, then the appropriate certificates (safety, emissions) should be displayed either in the applicable work area or in the office area where the station certificate is displayed.

6.3 CONSUMER PROTECTION CONSIDERATIONS

Most of the considerations discussed above could be thought of as being oriented toward consumer protection. These included licensed stations, periodic recertification, posted signs and labor rates, and certified inspectors.

These areas more or less deal with the motorist prior to his vehicle being inspected and/or serviced and repaired. Other considerations become evident in the process of receiving the required inspection/service and, subsequently, when paying for the inspection or repairs.

6.3.1 Preliminary Cost Estimate

Prior to performing any repairs to a vehicle, the station should inform the owner (or his designate) of the items requiring repair, replacement, or adjustment, along with the associated costs. The cost estimate should be in writing on a station form. The motorist is not obligated to have the necessary maintenance performed at the inspecting station. Cost estimates should be valid for a limited number of days, and so specified on the station form provided to the owner.

6.3.2 Parts Replacement

Original parts of the vehicle, when removed and replaced, should be returned to the owner. At the owner's option, the removed parts may be left at the station for disposal. If rebuilt, remanufactured, or reconditioned parts are used to effect the repair, the owner's invoice should so indicate.

6.3.3 Consumer Complaint Procedure

Licensed stations should display a summary of the complaint procedure. If the vehicle owner is dissatisfied with the repair and/or costs and cannot achieve a satisfactory agreement with the station operator, he should be afforded the opportunity to have the case arbitrated or investigated without going through small claims court.

The posted procedure should identify the responsible State department, the appropriate mailing address, any necessary information required, a toll-free telephone number, and business hours and days.

6.3.4 Request-for-Waiver Procedure

Upon receipt of a preliminary cost estimate, the vehicle owner may believe that the expenses necessary to satisfy the safety and/or emission standards may be more than he would want to invest in the particular vehicle. The State should establish an upper limit, perhaps as a function of vehicle age, beyond which repairs are not warranted. However, effective repairs shall be accomplished below this limit.

As an example, after receiving at least three cost estimates, the motorist is faced with an engine repair costing $200 to $250. The vehicle is a 1964 model with 100,000 cumulative miles and worth $250 on a used-car lot. Should he be required to invest a minimum of $200 to satisfy the emission standards? Would a more reasonable approach include major ignition and carburetion work costing up to $100 and achieve less-than-maximum emission reduction? In cases involving relatively large expenditures that would be disproportionate to the market value of the subject vehicle, it seems that some upper limit would be warranted. However, the waiver should not be granted indefinitely. That is, a finite waiver period should be granted, after which the repairs are made or the vehicle is removed from highway use. Vehicles operating under a waiver should not be resold without satisfying the applicable inspection standard.

6.4 APPROVED EMISSION CONTROL PRACTICES

The Department of Health currently is evaluating various approaches to reduce further total exhaust emissions. When these evaluations are completed, the accepted practices should be disseminated to participating licensed stations. The public information program office should advise the public through the communications media and through the previously described information pamphlets.

6.4.1 Retrofit Devices

Based on the Health Department's investigation results, approved devices should be identified by type and manufacturer. Emission reduction potential should be described along with any effects on performance and fuel economy. Because of the many different devices that may become available, the Department should recommend a maximum installed cost.

Retrofit devices not currently evaluated by the Department may subsequently be submitted for qualification and approved for installation. The department should establish the procedure for obtaining approved status. The following information should be considered during the qualification process.

- Device description — a summary of theory of operation, physical description and applicable graphics.

- Emission reduction — test data including vehicle sample size and description, emission baseline levels, emission level with device installed, and identification of recognized emission test laboratory and/or emission measurement system and procedures used.

- Performance and fuel economy — description and data on any driveability testing and fuel economy measurements.

- Installation procedures — description of installation procedures, identification of special equipment or calibration, any special personnel training.

- Product distribution — definition of product distribution policy, qualified installers.

- Owner cost — proposed cost of unit including installation and any post-installation maintenance requirements in terms of cumulative mileage or time interval, with associated costs.

SECTION 7

LEGISLATIVE CONSIDERATIONS

This section evaluates the existing EPA policies on the modification of vehicle engines to achieve emission reductions. The State of Colorado, in Senate Bill 393, has empowered the Air Pollution Control Commission to adopt rules and regulations applicable to engine modifications. Senate Bill 2236 of the U.S. Senate presently is being considered for enactment to amend the Clean Air Act. This bill provides for revised standards for vehicles used in high altitude areas. Vehicle modifications as they affect a manufacturer's warranty also are evaluated in this section.

7.1 FEDERAL EPA POLICY

The EPA Office of Air Programs issued on June 8, 1972, an Advisory Circular on engine modification for high altitude operation (see Appendix G). Subsequently, the EPA Office of Enforcement and General Counsel issued the Interim Tampering Enforcement Policy on December 22, 1972 (see Appendix H). Both of these policy statements, as they affect the Colorado vehicle emission control strategies, are presented below.

7.1.1 Emission Control System Modifications

For vehicles or engines intended for sale at high altitudes, the EPA Advisory Circular establishes the procedures whereby manufacturers may request the changes. Upon EPA approval for modifying production vehicles or engines, field fixes would then be allowed on current model year vehicles in the hands of the ultimate purchaser. The procedure for obtaining EPA approval is summarized below. Appendix G contains a copy of the EPA Advisory Circular.

- Submit requests for emission control modifications in accordance with 40 CFR 85.58.
- For modifications to an engine-system combination of certified vehicle or engine, run 50,000 mile Durability and 4,000 mile Emission Data vehicle testing. If the modification does not alter the configuration of the engine-system combination, then only the 4,000 mile Emission Data vehicle testing is required. An example of this type of modification would be alternate carburetor calibration. Durability and Emission Data testing would be required for other modifications such as the addition of an air pump.
- Vehicles or engines modified for high altitude operations must be capable of demonstrating that they meet all applicable EPA emission control standards when tested at the EPA laboratory.
- Manufacturers are encouraged to show by comparative test data the effects of the modifications on modified and unmodified vehicles or engines operating at high altitudes to assist the EPA in determining the impact of these modifications on air quality.
- Labels prescribed under 40 CFR 85.4 shall indicate the engine tune-up specifications of the modified

vehicle or engine for the high altitude where the vehicle or engine is intended to be sold.

7.1.2 Interim Tampering Policy

The Clean Air Act specifically prohibits any person to remove or render inoperative any device or element of design installed on a vehicle or engine in compliance with the regulation prior to its sale and delivery to the ultimate purchaser, or for any manufacturer or dealer to remove or render inoperative such design elements after sale and delivery to the ultimate purchaser. The Act provides for a maximum civil penalty of $10,000 for any person who performs any of the prohibited actions.

The Interim Policy, as included in Appendix H, states that the EPA's primary objective in enforcing the statutory prohibition of tampering is to assure unimpaired emission control of a motor vehicle during its useful life. Part of this policy is directed toward the after market replacement of parts relating to or affecting emission control. However, the scope of this section and the study in general is vehicle engine modification and retrofit devices. On this subject, the EPA will not regard the following acts, when performed by dealers, to constitute violations of the Act:

- Use of non-original equipment, after market part or system as an add-on, auxiliary, augmenting, or secondary part or system, if the dealer has a reasonable basis for knowing that such use will not adversely affect emissions performance.

- Adjustments or alterations of a particular part or system parameter if done for purposes of maintenance or repair according to manufacturer's instructions, or if the dealer has a reasonable basis for knowing that such action will not adversely affect emissions performance.

A reasonable basis can be established from one of the following conditions:

- The dealer knows of emission tests performed in accordance with EPA requirements which showed that the act did not cause similar vehicles or engines to fail to meet applicable emission standards for their useful lives (5 years or 50,000 miles in the case of light-duty vehicles); OR

- The part or system manufacturer represents in writing that tests as described in the item above have been performed with similar results; OR

- A federal, state, or local environmental control agency expressly represents that a reasonable basis exists.

The EPA presumes that the permanent removal, disconnecting, or blocking of any part of the original system installed primarily for emission control will adversely affect emission performance. Additionally, the prescription and appropriate publication of any prohibited act will be deemed conclusive that such an act will adversely affect emission performance.

Dealers who install add-on parts or retrofit devices are protected against the tampering policy if:

- The part manufacturer represents in writing that emission tests have been performed according to federal procedures. Test results need not have been reported to EPA, but the parts manufacturer must have information available on test data, including where, when, how and by whom tests were conducted, should EPA request it.

- The retrofit devices were installed to reduce emissions at the request of a state or local environmental control agency.

Dealers who perform necessary adjustments or alterations are protected under the following conditions:

- Adjustments or alterations are performed on parts already on the vehicle in accordance with vehicle manufacturer's instructions.

- Adjustments or alterations are performed as part of altitude fixes where a reasonable basis exists, as previously described, that such action will not adversely affect emission performance.

7.2 COLORADO LEGISLATION

Senate Bill 393, "Concerning Air Pollution Control and Providing for the Establishment of a Motor Vehicle Emissions Control Program," authorizes the Air Pollution Control Commission to accomplish the following (Ref. 16):

- Adopt regulations concerning high altitude tuning specifications to control motor vehicle emissions in the State. (66-31-27)

- Adopt regulations for the proper connection and operation of air pollution control devices installed by the manufacturer in any motor vehicle for the purposes of controlling vehicle emissions. (13-5-113-2c)

- Adopt rules and regulations governing other air pollution control devices. (13-5-113-2c)

- Adopt rules and regulations which permit or allow for the alteration, modification, or disconnection of manufacturer-installed air pollution control systems or manufacturer tuning specifications on motor vehicles for the purpose of controlling vehicle emissions. (13-5-160)

Thus, it appears that the State has empowered the Commission with sufficient authority to require the installation of retrofit devices and/or to alter or modify the vehicle or engine to affect emission reductions. In view of the EPA policy statement, the delegated authority, coupled with the emission test data as reported in other volumes of this report, should provide the reasonable basis for requiring these post-delivery changes to the vehicles.

7.3 U.S. SENATE BILL 2236

The Senate Bill 2236, as proposed on July 24, 1973, was to amend the Clean Air Act in order to provide for revised standards for motor vehicles and engines to be sold or used in high altitude areas (Ref. 17). Currently being reviewed by the Committee on Public Works, the bill directs the EPA to determine special requirements for emission control devices and systems in high altitude states and the maintenance thereof, and directs vehicle and engine manufacturers to meet these standards.

As used in the bill, a high altitude state means one having a standard metropolitan statistical area (SMSA) with an average elevation of at least 3,000 feet above sea level.

The bill proposes to amend the requirements on compliance testing and certification to include amended tests and standards with respect to high altitude vehicles and engines such that the standards established for the nation are complied with when the vehicle or engine is operated in a high altitude state. This requirement is applicable to vehicles and engines manufactured during and after model year 1976.

With respect to state standards, the bill proposes to add the stipulation that the Clean Air Act does not preclude or deny to any state or political subdivision thereof the right to require that vehicles and engines licensed for use in that state be in conformity with the standards established for the class or classes of new motor vehicles or engines.

7.4 MANUFACTURER'S WARRANTY REQUIREMENTS

The altering, modifying, or retrofitting of vehicles and engines such that lower emissions result appears to be legally acceptable by the EPA in view of its interim tampering policy. For newer model vehicles which are operating within the warranty limitations, the issue is whether these after market emission reduction actions would lead to an infringement or non-compliance of warranty requirements.

A letter describing the current Colorado Health Department study on vehicle modifications was sent to four major domestic manufacturers (American Motors, Chrysler Motors, Ford and General Motors) and to three major foreign manufacturers (Volkswagen, Toyota and Nissan). Appendix I contains a copy of the inquiry letter, addressees and responses.

7.4.1 Emission Control System

The warranty for 1972-and-newer models states that the vehicle is free at the time of sale from defects in material and workmanship which would cause the vehicle to fail to conform with EPA regulations for a period of 5 years or 50,000 miles. Since the warranty covers the emission control system as configured during the time of sale, the addition of after market devices would not affect the manufacturer's warranty. However, if failure to conform to EPA regulations occurs subsequently, then the question of whether the failure was caused by a defect existing at the time of sale or by the addition of the after market device will have to be evaluated in terms of the EPA Interim Tampering Enforcement Policy.

7.4.2 Parts Replacement or Modifications

For vehicles covered by existing new car warranties, the use of a nonoriginal-equipment-manufacturer (non-OEM) part or modification would not void the warranty. However, if the use of such a part or modification causes failure of other OEM components, the warranty would not cover the replacement of the affected components.

REFERENCES

1. "Vehicles-in-Use Inspection Standards," U.S. Department of Transportation, NHTSA, as recorded in the Federal Register, Vol. 38, No. 171. 5 September 1973.

2. "Rules, Regulations and Requirements for Motor Vehicle Official Inspection Stations." State of Colorado, Department of Revenue, Motor Vehicle Division, DR PUB 15. Effective July 1, 1967, as amended.

3. "Motor Vehicle Safety Inspection Program Study." Olson Laboratories, Inc. Prepared under contract agreement for the State of Colorado, Department of Revenue, Motor Vehicle Division. 15 November 1972.

4. "Mandatory Vehicle Emission Inspection and Maintenance." Northrop Corporation in association with Olson Laboratories, Inc. Under Contract ARB 1522 with the State of California Air Resources Board. December 1971.

5. "Vehicle Emission Inspection and Control Program." Olson Laboratories, Inc., under contract agreement 25 May 1972, with the State of Colorado, Department of Health. November 1972.

6. "Effectiveness of Short Emission Inspection Tests in Reducing Emissions through Maintenance - THE SHORT CYCLE PROJECT." Olson Laboratories, Inc., under EPA Contract 68-01-0410, for EPA Office of Air and Water Programs. July 31, 1973.

7. "Requirements for Preparation, Adoption, and Submittal of Implementation Plans." EPA Transportation Control Measures, recorded in Federal Register, Vol. 38, No. 8. 12 January 1973.

8. "A Study of Mandatory Engine Maintenance for Reducing Vehicle Exhaust Emissions." TRW in association with Scott Research Laboratories, prepared for CRC and EPA, APRAC CAPE-13-68. July 1972.

9. "Analysis of Effectiveness and Costs of Retrofit Emission Control Systems for Used Motor Vehicles." Olson Laboratories, Inc., prepared under EPA Contract 68-04-0038 for the U.S. EPA, Office of Air Programs. May 1972.

10. "Automotive News Almanac Issues," 1973, 1972, 1971. Marketing Services, Inc., Division of Crain Communications, Inc. Detroit, Michigan.

11. "Vehicle Emission Testing Program, Final Report for the Concept and Criteria Phase." Olson Laboratories, Inc., prepared under contract for the City of Chicago. February 1973.

12. "Auto Air Pollution Questionnaire, Denver Metropolitan Area." TRW. Part of a report prepared for the EPA Region VIII, Denver. 1972.

13. "Air Pollution Research Report." Alire, L. and Clark, D. Student paper presented to Dr. R. Beatty, University of Colorado, Boulder. 1972.

14. "Public Response to Air Pollution in the Denver Area." Jones, S. University of Colorado, Institute of Behavioral Science. 9 August 1973.

15. "The State of Colorado Air Pollution Control Transportation and Land Use Plan." Colorado Department of Health. 14 May 1973.

16. Colorado Senate Bill 393, "Concerning Air Pollution Control, and Providing for the Establishment of a Motor Vehicle Emissions Control Program, and Making an Appropriation Therefor." 1973.

17. U.S. Senate Bill 2236, Dominick, 24 July 1973, 93 Congress, First Session, to amend the Clean Air Act.

APPENDIX A

NHTSA INSPECTION STANDARDS

APPENDIX A

NHTSA INSPECTION STANDARDS*

Vehicle System	Function Tested	Inspection Procedure
Service Brake	Failure indicator lamp	Apply parking brake and turn ignition to start, or verify operation following manufacturer's method.
	Brake system integrity	With engine running for power assist brakes, and ignition turned to "on" for others, apply force of 125 pounds for 30 seconds. Note any pedal height decrease, and whether failure indicator illuminates.
	Brake pedal	Measure distance (A) from free pedal position to floorboard or other object restricting pedal travel. Similarly, apply force to brake pedal and measure distance (B). Determine percentage as (A-B)/A x 100. Failure occur if greater than 80 percent. Engine must be running for power assist brakes. Pedal reserve check not required for vehicles with full power (central hydraulic) brake systems or for brake systems designed to operate with greater than 80 percent pedal travel.

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*Extracted from "Vehicle In Use Inspection Standard," U.S. DoT, NHTSA, recorded in Federal Register, Volume 38, No. 171 5 September 1973.

Vehicle System	Function Tested	Inspection Procedure
	Service brake performance	Verify that tire inflation pressure within limits recommended by vehicle manufacturer. Perform either (a) or (b) of the following. a. Roller-type or drive-on platform - test must measure equalization. Follow test equipment manufacturer's specification. Left to right brake force variance not to exceed 20 percent for front tests or rear tests. b. Road test - conducted on a level (not to exceed ± 1 percent grade) dry, smooth, hard surfaced road that is free from loose material, oil, or grease. Apply service brakes at vehicle speed of 20 mph. Vehicle shall be brought to a stop within 25 feet or less without leaving a 12-foot wide lane.
	Brake hoses and assemblies	Visually examine hoses and note that they are not mounted so as to contact vehicle body or chassis, and not cracked, chafed or flattened. Inspect through all wheel positions from full left to full right.
	The following three tests require the removal of at least one front and one rear wheel.	
	Disc and drum condition	Visually examine for conditions within specifications if drum is embossed with maximum safe diameter dimension or rotor is embossed with minimum safety thickness dimension. If not embossed, the drums and discs shall be within the manufacfacturer's specifications.

Vehicle System	Function Tested	Inspection Procedure
	Friction material	Visually examine and note that lining or pad thickness shall not be less than one thirty-second of an inch over the rivet heads, or the brake shoe on bonded linings or pads. Linings and pads shall not have cracks or breaks that extend to rivet holes except minor cracks that do not impair attachment. Linings shall be securely attached to brake shoes, pads shall be securely attached to shoe plates.
	Structural and mechanical parts	Visually examine backing plates and caliper assemblies and note that they are not deformed or cracked. System parts shall not be broken, misaligned, missing, binding, or show evidence of extreme wear. Automatic adjusters and other parts shall be assembled and installed correctly.
Brake Power Unit	Vacuum hoses	With engine running, visually and aurally examine hoses and note that they are not collapsed, abraded, broken, improperly mounted, or audibly leaking. Stop engine and deplete residual vacuum by applying service brakes several times. Apply constant 25-pound force on brake pedal, and start engine. Brake pedal should fall slightly. This test not applicable to vehicles equipped with full power brake system for which the service brake test shall be adequate.

Vehicle System	Function Tested	Inspection Procedure
Steering System	System play	With engine running and wheels in straight ahead position, turn steering wheel in one direction until perceptible movement of front wheel is noted. Arbitrary point on steering wheel rim shall not move more than value shown below before this perceptible movement is noted. If value is exceeded there is excessive lash or free play in steering system. Steering Wheel Diameter (Inches) — Lash (Inches) 16 or less — 2 18 — 2 1/4 20 — 2 1/2 22 — 2 3/4
	Linkage play	Elevate vehicle front end to load ball joints. Insure that wheel bearings are correctly adjusted. Grasp front and rear of tire and attempt to turn tire and wheel assembly left and right. Free movement at front or rear tire tread shall not exceed one-quarter inch.
	Free turning	Turn steering wheel through limit of travel in both directions. Feel for binding or jamming in steering gear mechanism.
	Alignment	Measure toe-in and toe-out using scuff gauge and note that recorded value does not indicate greater than 30 feet per mile. If equivalent device is used, follow manufacturers instructions.

Vehicle System	Function Tested	Inspection Procedure
	Power steering system	Visually examine for cracked or slipping pump belts or insufficient fluid in reservoir.
Suspension System	Suspension condition	Visually examine and note that ball joint seals shall not be cut or cracked, structural parts shall not be bent or damaged, stabilizer bars shall be connected, springs shall not be broken or extended by spacers. Shock absorber mountings, shackles, and U-bolts shall be securely attached. Rubber bushings shall not be cracked, extruded out from or missing from suspension joints. Radius rods shall not be missing or damaged.
	Shock absorber condition	Visually examine shock absorbers for oil leaking from seals. Push down on one end of vehicle, release, and note that number of cycles of free rocking motion does not exceed two cycles. Repeat procedure at other end of vehicle.
Tires	Tread depth	Visually examine each tire tread and note that tread shall not be less than two thirty-seconds of an inch deep. Passenger car tires have tread depth indicators which become exposed when tread depth is less than two thirty-seconds of an inch. Inspect for indicators in any two adjacent major grooves at three locations spaced approximately equally around outside of tire. For other than passenger cars, it may be necessary to use tread gauge.

Vehicle System	Function Tested	Inspection Procedure
Wheel Assemblies	Type	Visually examine for major mismatch in nominal size, construction, and profile between tires on same axle, or for major deviation from manufacturer's recommendation (for 1968 and newer vehicles see glove box placard).
	General conditions	Visually examine and note that tires shall be free from chunking, bumps, knots, or bulges evidencing cord, ply, or tread separation from the casing or other adjacent materials.
	Wheel integrity	Visually examine and note that tire rim, wheel disc, or spider shall not have visible cracks, elongated bolt holes, or indication of repair by welding.
	Deformation	Using runout indicator gauge and suitable stand, measure lateral and radial runout of rim bead through one full wheel revolution. Runout shall not exceed three thirty-seconds of an inch.
	Mounting	Check wheel retention by noting that all wheel nuts and bolts are in place and tight.

APPENDIX B

DRAFT OF RECOMMENDED INSPECTION PROCEDURE, EQUIPMENT, AND REJECTION LIMITS

INSPECTION PROCEDURE, EQUIPMENT, AND REJECTION LIMITS

STATE OF COLORADO
DEPARTMENT OF REVENUE
MOTOR VEHICLE DIVISION

Issue Date:

Revisions affecting this document:

Change Date	Pages	Remarks

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Section		Page
I	Wheels and Tires	
II	Steering, Alignment and Suspension	
III	Brakes	
IV	Lighting and Electrical Systems	
V	Vehicle Glazing	
VI	Body and Sheet Metal	
VII	Exhaust and Fuel Systems	

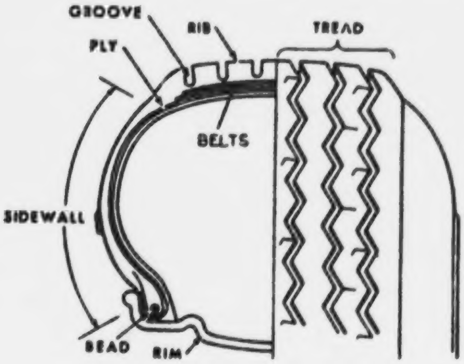
SECTION I

WHEELS AND TIRES

Reference is made to the additional wheel and tire information shown in Figures 1 and 2 for visual aid in determining tire wear. This inspection is visual.

Procedure	Equipment	Reject Vehicle
A. Inspect for tire wear	Tread depth measuring gauge	A. Reject as follows:
1. Tires without tread wear indicators		1. If tire is worn so that less than 2/32 inch tread remains when measured in any two adjacent major grooves at three locations spaced approximately equally around outside of tire (Figure 2(c))
2. Tires with tread wear indicators		2. If tire is worn so that the tread wear indicators contact the road in any two adjacent major grooves at three locations spaced approximately equally around outside of tire (Figure 2(a))
3. Inspect for cord exposure		3. If tire has a worn spot that exposes the cord through the tread
B. Inspect for tread cuts, snags, or sidewall cracks		B. If tire has tread cuts, snags, or sidewall cracks in excess of 1 inch in any direction, and deep enough to expose cords
C. Inspect for bumps, bulges, or knots		C. If tire has visible bumps, bulges, or knots indicating partial failure or separation of the tire structure
D. Inspect for regrooved or recut tires		D. If tire has been regrooved or recut below original groove depth, except special tires which have undertread rubber for this purpose and can be identified as such
E. Inspect for mismatching of tires		E. If tires are not same type or size on one side of vehicle as on other (difference in brand or tread are not cause for rejection)
F. Inspect for tire size		F. If tires are smaller than manufacturer's specified minimum or larger than specified maximum

Procedure	Equipment	Reject Vehicle
G. Inspect wheel bolts, nuts or lugs		G. If wheel bolts, nuts, studs, or lugs are loose, missing, or damaged
H. Inspect for wheel damage		H. If any part of wheel is bent, cracked, re-welded, or damaged so as to affect safe operation of vehicle
I. Visually inspect for restricted usage marking on tire (reclassified tires)		I. If tire is marked "for farm use only," "off-highway use only," "for racing use only," etc.
J. Front tire and wheel runout	Portable gauge to measure play	J. If runout is greater than 1/4" (measured as indicated in Figure 2(b))



Definitions

RIM - A metal support for a tire or a tire and tube assembly upon which the tire beads are seated.

BEAD - That part of the tire made of steel wires wrapped or reinforced by ply cords: that is, shaped to fit the rim.

SIDEWALL - That portion of the tire between tread and bead.

CORD - The strands forming the plies in the tire.

PLY - A layer of rubber-coated parallel cords.

TREAD - That portion of the tire that comes into contact with the road.

TREAD RIB - The tread section running circumferentially around the tire.

GROOVE - The space between two adjacent tread ribs.

BELT - A layer or layers made of fabric or other material located under the tread area.

Figure 1. TIRE CONSTRUCTION

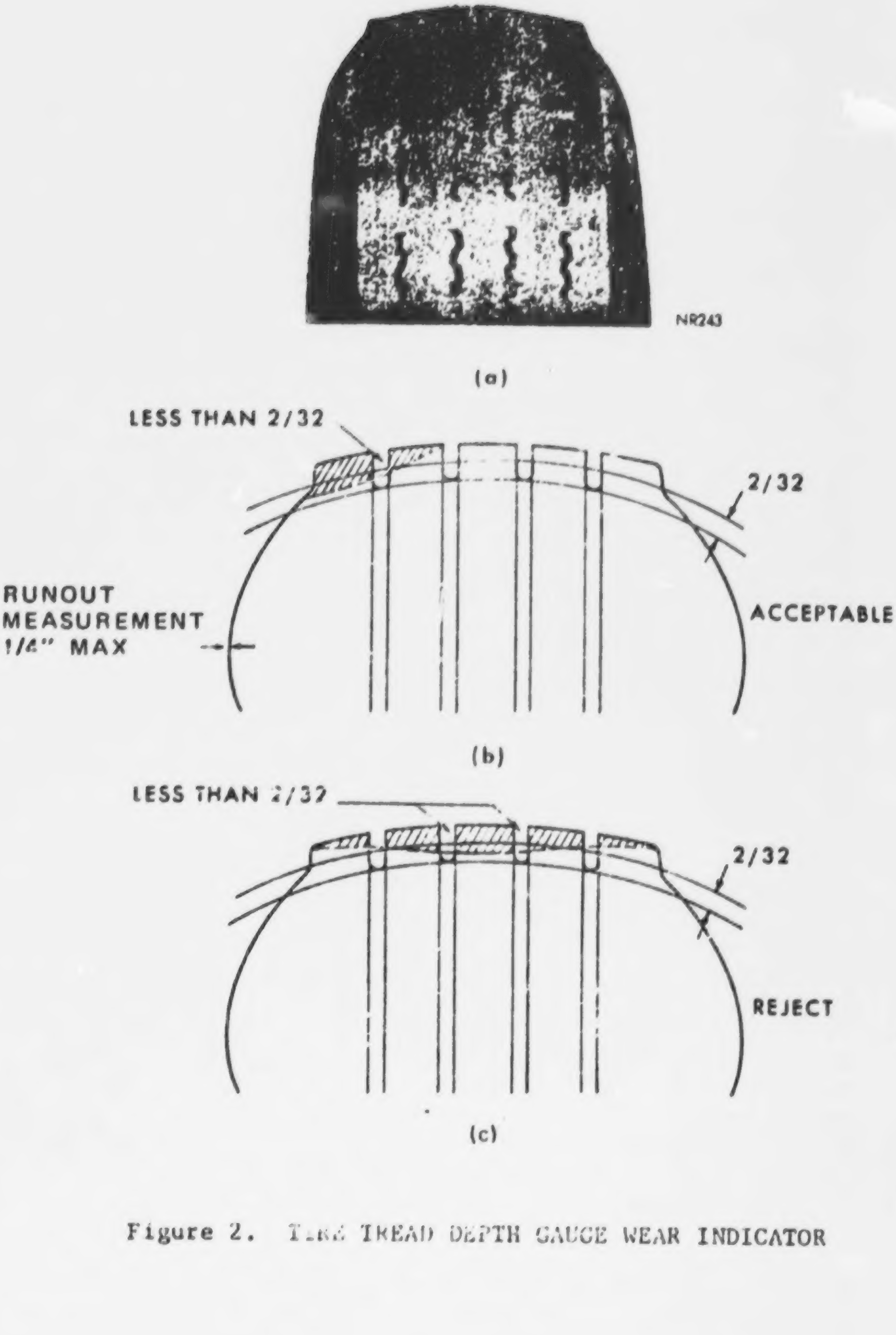

NR243
(a)
LESS THAN 2/32
2/32
RUNOUT MEASUREMENT 1/4" MAX
ACCEPTABLE
(b)
LESS THAN 2/32
2/32
REJECT
(c)

Figure 2. TIRE TREAD DEPTH GAUGE WEAR INDICATOR

SECTION II

STEERING ALIGNMENT AND SUSPENSION

The steering system of the vehicle must be inspected to determine if excessive wear and/or maladjustment of the linkage and/or steering gear exists. The vehicle must be on a dry surface. On vehicles equipped with power steering, the engine must be running and the fluid level and belt tension must be adequate before testing.

Procedure	Equipment	Reject Vehicle
A. Lash or Free Play - With road wheels in straight-ahead position, turn steering wheel until turning motion can be observed at road wheels; measure lash		A. If more than 2 inches of total movement at steering wheel rim is encountered before front road wheels move
B. Travel - Lift one front wheel off surface; turn steering wheel through a full right and left turn and feel for binding or jamming conditions	Floor jack	B. If front wheels are incapable of being turned to right and left steering stops without binding or interference

LINKAGE AND RELATED PARTS - The steering system and related linkage and parts must be inspected to determine possible wear or damage to all points.

WHEEL BEARINGS - Wheel bearings out of adjustment can cause wander, erratic front brake action, and noise due to interference of parts.

C. Wheel Bearings - With front end of vehicle lifted properly, grasp front tire top and bottom, rock it in and out, and record movement; to verify that any looseness detected is in wheel bearing, notice relative movement between brake drum or disc and backing plate or splash shield (Figure 4)	Floor jacks or hoist; lift to load ball joints 1. Spring or torsion bar on lower arm, hoist at frame (Figure 3) 2. Spring or torsion bar on upper arm, hoist at lower arm close to ball joint (Figure 5)	C. If relative movement between drum and backing plate is excessive (more than 1/8-inch measured at outer circumference of tire)

(NOTE - Wheel bearing play can be eliminated by applying service brakes)

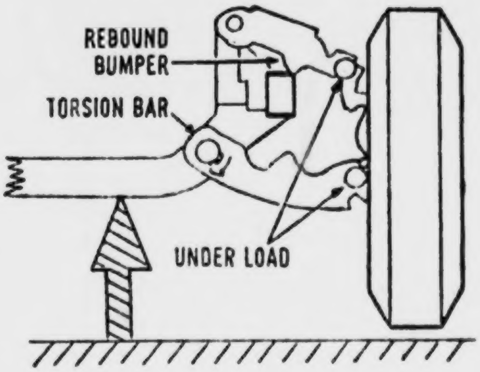


Figure 3

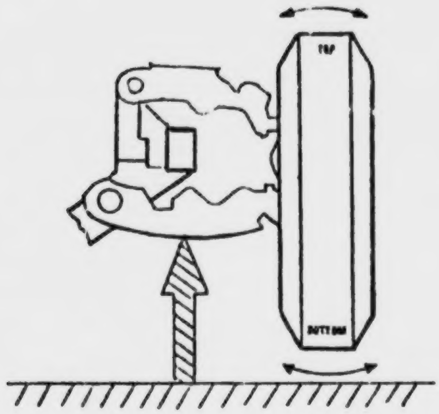


Figure 4

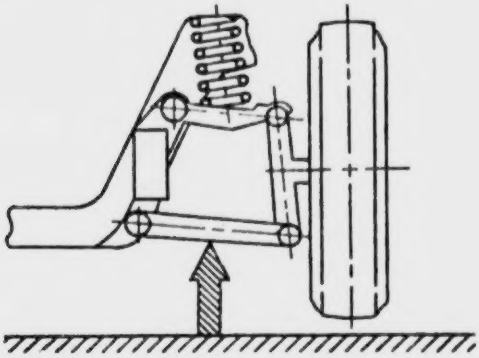


Figure 5

<table>
<tr><th>Procedure</th><th>Equipment</th><th>Reject Vehicle</th></tr>
<tr><td colspan="3">LINKAGE PLAY - Excessive free play causes wheel shimmy, erratic brake action, and steering control problems. Make sure any looseness detected is not wheel bearing free play.
SPRING OR TORSION BAR HEIGHT - Optimum front spring height is established as part of the overall design of front wheel alignment angles.</td></tr>
<tr><td>D. Steering Linkage Play - With front end lifted properly, grasp front and rear of tire and attempt to turn assembly right and left; record movement at extreme front or rear of tire (Figure 6)</td><td>Follow procedure C for correct lifting.
Brakes should be applied during inspection either by another person or by use of a portable</td><td>D. If measurement is found to be in excess of:
Wheels
1/4 inch - 16 inches or less
3/8 inch - 17 and 18 inches
1/2 - over 18 inches</td></tr>
</table>

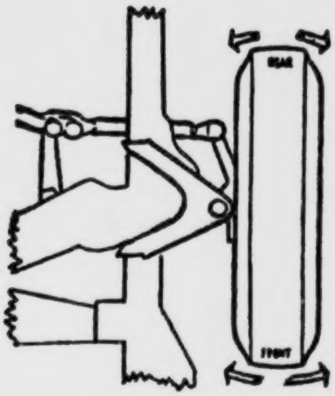


Figure 6

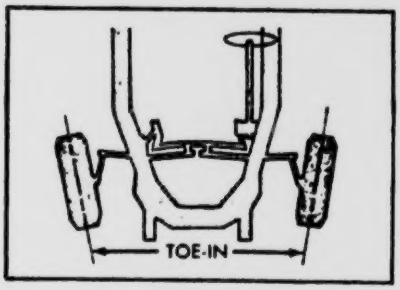


Figure 7

Procedure	Equipment	Reject Vehicle
	brake depressor to eliminate wheel bearing play Portable gauge to measure play	

FRONT WHEEL ALIGNMENT - There are five basic factors which are the foundation to front wheel alignment: caster, camber, toe-in, steering axis inclination, and toe-out in turns. All are mechanically adjustable except steering axis inclination and toe-out on turns. Overall front wheel alignment can be somewhat grossly indicated by measurement of front wheel toe. Excessive toe-in or toe-out is a general indication that a complete check should be made of all front wheel alignment factors.

F. Toe (In-Out) (Figure 7) - With wheels held in a straight-ahead position, drive vehicle slowly over measuring device; record results	Drive-on sideslip indicator	E. If slideslip (or scuff) is found to be in excess of 30 feet per mile Where caster, camber, or toe-in are so excessively out of adjustment as to be apparent visually

BALL JOINTS MUST BE UNLOADED FOR INSPECTION.

NOTE: "Vertical" movement of ball joints is referred to in some shop manuals as "axial" movement.

F. Ball Joint Wear - With front end of vehicle lifted properly and front wheel bearing adjusted properly:	Dial indicator, swivel and stand; floor jack safety stand; lift vehicle to unload ball joints	F. If ball joint movement is in excess of manufacturers' specifications shown in Figures 10 and 11

Procedure	Equipment	Reject Vehicle
Attach dial indicator to lower control arm (Figure 8) to accurately measure horizontal or vertical movement between ball joint and its socket Grasp tire and wheel assembly at 11 and 5 o'clock positions on tire; check movement of the wheel by moving top and bottom of tire in and out, using sufficient hand load to take any clearance, but not in excess to deform tire or suspension; repeat operation at 1 and 7 o'clock positions.	1. Spring or torsion bar on lower arm, lift vehicle at lower arm (Figure 9); position stand as far outboard as possible	If the ball joint seals are cut, torn, or otherwise damaged
(NOTE - Measure tolerances as indicated in Figures 12(a) and 13(a))		
Position a pry bar under front tire and wheel, and with a lifting motion move wheel (using sufficient loading to take up any clearance) up and down; observe movement shown on dial indicator	2. Spring or torsion bar on upper arm, lift vehicle at front crossmember (Figure 14); wheel and lower support arm must be free	
(NOTE - Measure tolerances as indicated in Figures 12(b) and 13(b)		

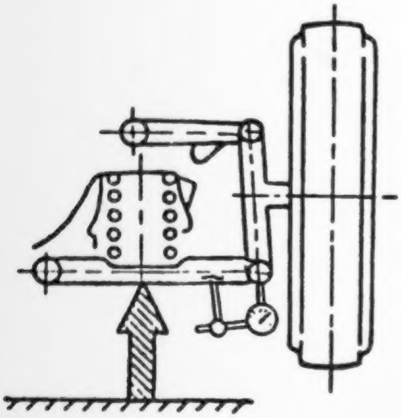


Figure 8

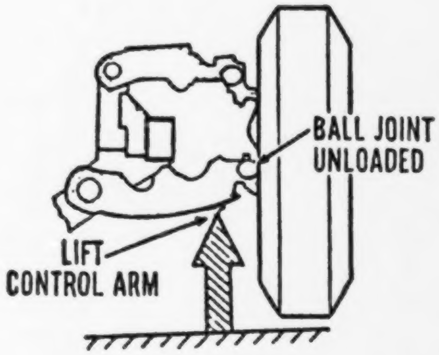


Figure 9

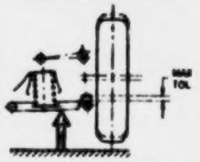
BALL JOINTS - MANUFACTURER'S TOLERANCES WITH SPRING OR TORSION BAR ON LOWER ARM

Hoist vehicle at lower arm as shown to unload ball joints.

1. Install floor stands under both RH and LH lower control arms, outboard as far as possible. Car must be stable.
2. Upper arm must be free from rubber bumper.
3. Wheel bearings must be properly adjusted.
4. Check ball joints according to chart.

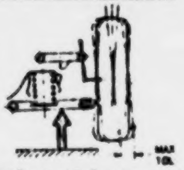
LOWER BALL JOINT

Vertical Movement



Replace if vertical movement exceeds tolerances listed below.

Horizontal Movement



Replace if horizontal movement exceeds tolerances listed below.

MODEL	YEAR	LOWER BALL JOINT	
		Vertical Movement	Horizontal Movement
Chrysler	57-64		
	65-72		
DeSoto	57-61		
Dodge	57-67		
	68-72		
Plymouth	57-67		
	68-72	.070"	
Valiant (Barracuda)	60-67		*
	68-72		
Dart (Lancer)	60-67		
	68-72		
Imperial	57-66		
	67-72		
Colt	71-72	Zero	
Cricket	71-72		
Edsel	58-60		
Ford	54-72		
Lincoln	52-72		
Mercury	54-72	.200"	
Pinto	71-72		.250"
Thunderbird	55-60		
	67-72		
	61-66	See Fig. 11	
Buick Special	61-63		
	64-68		
	69-72	.150"	*
Buick	57-60		
	61-70		
	71-72	Zero**	
Cadillac	57-72	.062"	*
ElDorado	67-72	.125"	*
Chevrolet	55-63		
	64-70		.250"
Chevelle	64-70	.100"	
Corvair	60-63		*
	64-70		*
Corvette	55-63	Not Applicable	—
	64-70	.070"	.250"
Camaro	67-69	.070"	.250"
	70-72	Zero**	*
Chevy II (Nova)	62-67	See Fig. 11	—
	68-70	.060"	.250"
All Models (Incl. Vega)	71-72	Zero**	*
Oldsmobile F85	61-63		
	64-72		
Toronado	66-72	.125"	*
Oldsmobile	57-70		
	71-72	Zero**	
Pontiac	58-64		*
Pontiac	65-70		*
Tempest	61-63	.100"	.250"
	64-		.250"
Tempest (Le Mans)	65-69		
Grand Prix—Le Mans	70-72		
Firebird	70-72	Zero**	
Pontiac (Bonneville, etc)	71-72		

*Do not test ball joints by reading horizontal movement of tire.
**Preloaded in rubber. Can be inspected only after removal from steering knuckle.

Figure 10

BALL JOINTS - MANUFACTURERS' TOLERANCES WITH SPRING OR TORSION BAR ON UPPER ARM

Hoist vehicle as shown to unload ball joints.

1. Hoist vehicle on frame crossmember or side rails.
2. Wheel bearings must be properly adjusted.
3. Check ball joints according to chart.

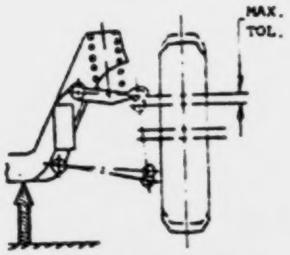
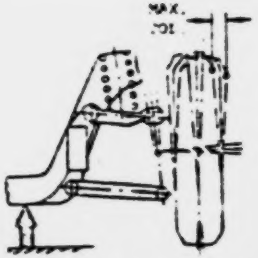
MODEL	YEAR	UPPER BALL JOINT	
		Vertical Movement  Replace if vertical movement exceeds tolerances listed below.	Horizontal Movement  Replace if horizontal movement exceeds tolerances listed below.
MAVERICK COMET COMET METEOR	69-72 60-62 63-72 62-63	.200"	.250
FALCON FALCON FAIRLANE MUSTANG COUGAR	60-62 63-72 62-72 65-72 67-72	.200"	.250
THUNDERBIRD	61-66 67-72	.200" See Figure 10	.250
CHEVY II CHEVY II	62-63 64-67	.100"	.250
INTERNATIONAL 1000 - TRAVELALL	60-72	.095"	Do not test horizontal movement
AMERICAN MOTORS-ALL MODELS	62-69	NO UPPER BALL JOINT	
AMERICAN MOTORS-ALL MODELS	70-72	.080"	.160"

Figure 11

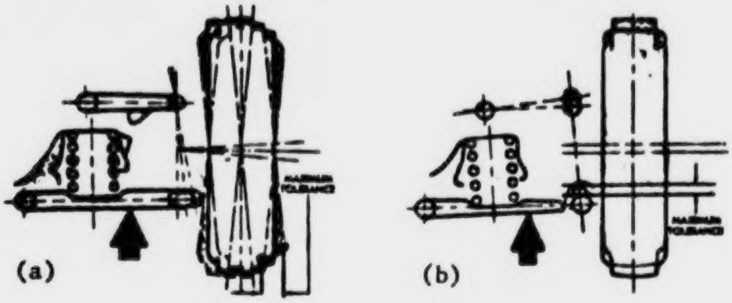


Figure 12

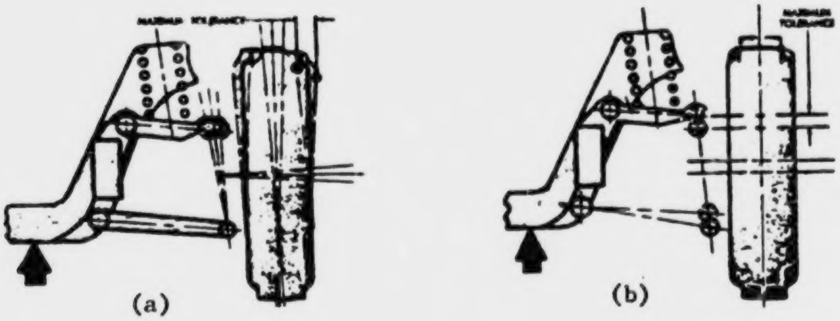


Figure 13

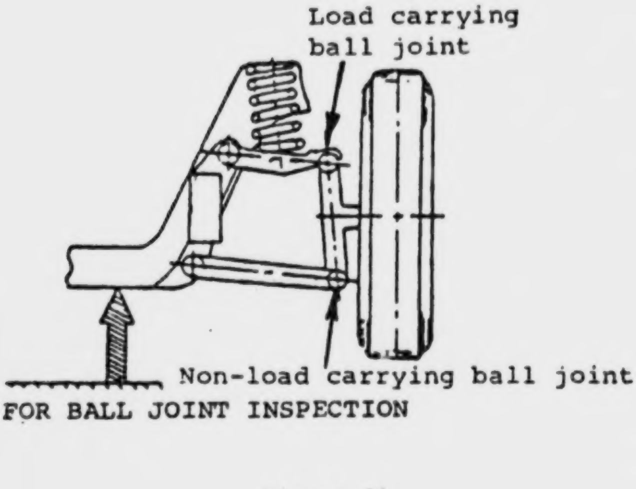

Load carrying ball joint
Non-load carrying ball joint
FOR BALL JOINT INSPECTION

Figure 14

<table>
<tr><th>Procedure</th><th>Equipment</th><th>Reject Vehicle</th></tr>
<tr><td colspan="3">Sagging springs, broken torsion bars, worn or deteriorated bushings, loose shackles and loose or mislocated "U" bolts can cause vehicle handling instability and brake pull.</td></tr>
<tr><td>G. <u>Springs</u> - With unloaded vehicle on a level surface, visually inspect heights of four corners of vehicle; if necessary, use measuring device and determine differences from side to side; visually inspect for broken leaves or bar damage; inspect spring shackles, bushings, and "U" bolts</td><td>Hoist or hydraulic jack, scale, and trouble light</td><td>G. If springs or torsion bars are broken
If shackles or "U" bolts are worn or loose</td></tr>
<tr><td>H. <u>Shock Absorbers</u> - With car on a hoist or jacked up, visually inspect shock absorbers for excessive leakage, and looseness of mounting brackets and bolts</td><td>Hoist or hydraulic jack and trouble light</td><td>H. If severe leakage (not slight dampness) occurs
If mounting bolts or mounts are broken or loose</td></tr>
<tr><td colspan="3">Possible causes for improper rear wheel tracking can consist of any one of the following:
Broken main leaf on rear spring; shifted axle on center bolt; bent or out-of-adjustment trailing links or radius rods, sway bar, or track bar; bent or damaged axle housing or frame.</td></tr>
<tr><td>I. <u>Rear Wheel Tracking</u> - Using a tape measure, determine distance between centerline of front wheel spindle and centerline of rear axle drive shaft and compare from side to side* (front wheels must be in straight-ahead position)</td><td>Measuring tape, hoist, hydraulic jack, and trouble light</td><td>I. If wheel base on one side is different from wheel base on other side by more than 1 inch*
If rear axle is obviously misaligned</td></tr>
</table>

---

*Not applicable if vehicle specifications indicate different left and right wheelbase dimensions as designed.

SECTION III

BRAKES

The engine should be running when checking vehicles with power-assisted hydraulic systems.

Procedure	Equipment	Reject Vehicle
A. Brake Hydraulic System Leakage - While vehicle is stopped, driver should be able to apply a moderate foot force (40-60 pounds in nonpowered systems, and 15-20 pounds in power-assisted systems) and maintain same pedal height for 1 minute	Pedal pressure gauge	A. If brake pedal height cannot be maintained for 1 minute
B. Pedal Reserve - While vehicle is stopped, depress brake pedal under moderate foot force (40-60 pounds in nonpowered systems and 15-20 pounds in power-assisted systems)	Pedal pressure gauge	B. If less than 1/5 of total available pedal travel remains

SIMPLE TESTS AND VISUAL INSPECTION PROCEDURES - Service brake tests should be conducted on a substantially level, dry, hard, smooth surface road or area that is free from loose material, oil, or grease. Using the service brake only, the stopping ability of the vehicle should be tested by the following method:

C. Service Brake - On Road - At a speed of 20 mph, apply service brakes firmly; observe whether vehicle comes to a smooth stop within distance prescribed by state law without pulling to the right or left causing it to leave a lane 12 feet wide; driver should have firm control of steering wheel throughout test	Tape measure or premarked lane	C. If vehicle does not stop within following limits: 4-wheel service brakes on any single vehicle or combination of vehicles - 40 feet 2-wheel service brakes on any single vehicle - 55 feet Hand brake on any vehicle or combination of vehicles - 55 feet

<table>
<tr><th>Procedure</th><th>Equipment</th><th>Reject Vehicle</th></tr>
<tr><td></td><td></td><td>If vehicle swerves enough for any wheel to leave the 12-foot lane</td></tr>
<tr><td>Drive vehicle over a premeasured distance (1/4-mile minimum) at a constant speed, and record elapsed time (maximum speed, 30 mph)</td><td>Stopwatch</td><td>If recorded elapsed time is not within 20% of estimated trip time</td></tr>
<tr><td colspan="3">BRAKE LININGS AND PADS - It is recommended that at least one front or one rear wheel and drum assembly be removed for inspection of linings on drum brakes.</td></tr>
<tr><td>D. Condition of Linings and Pads -</td><td></td><td>D. Reject as follows:</td></tr>
<tr><td>1. Bonded Linings - Measure lining thickness at thinnest point</td><td>Measuring device (steel scale or gauge)</td><td>1. If thinnest point is less than 1/16 inch</td></tr>
<tr><td>2. Riveted Linings - Inspect for loose or missing rivets</td><td>Steel scale or gauge</td><td>2. If any rivets are loose or missing</td></tr>
<tr><td>Measure lining thickness above rivet head at thinnest point</td><td></td><td>If lining is worn to within 3/32 inch</td></tr>
<tr><td>3. Wire-Backed Linings - Inspect for wire showing on friction surface of lining</td><td></td><td>3. If wire is visible on friction surface</td></tr>
<tr><td>4. All Linings - Inspect for broken or cracked linings, and parts of linings not firmly attached to shoe; Also for contamination and excessively uneven lining wear</td><td></td><td>4. If lining is broken, cracked, or not firmly and completely attached to shoe
If friction surface is contaminated with oil or grease
If lining wear is extremely uneven</td></tr>
</table>

<table>
<tr><th>Procedure</th><th>Equipment</th><th>Reject Vehicle</th></tr>
<tr><td colspan="3">NOTE: It is imperative that the brake system reservoir cover and the surrounding area be thoroughly cleaned before the cover is removed for inspection to assure that NO DIRT is mixed with the brake fluid.</td></tr>
<tr><td>E. <u>Hydraulic System</u> - Visually inspect condition of hydraulic system</td><td></td><td>E. Reject as follows:</td></tr>
<tr><td>1. <u>Wheel Cylinders</u> - Inspect for leakage</td><td></td><td>1. If wheel cylinders leak</td></tr>
<tr><td>2. <u>Hydraulic Hoses and Tubes</u> - Inspect for leaks, cracks, chafing, flattened, or restricted sections, and improper support</td><td></td><td>2. If hoses or tubing leak or are cracked, chafed, flattened, restricted, or insecurely fastened</td></tr>
<tr><td>3. <u>Master Cylinder</u> - Inspect for leakage and fluid level (Be sure no dirt gets into reservoir when cover is removed and that gasket is serviceable)</td><td>Steel scale</td><td>3. If master cylinder leaks
If fluid level is more than <u>3/4 inch</u> below top of reservoir
If gasket is torn or misshapen</td></tr>
<tr><td>F. <u>Dual Hydraulic Circuits</u> - In addition to above, if vehicle is equipped with a brake warning light:</td><td></td><td>F. Reject as follows:</td></tr>
<tr><td>Test operation of light</td><td></td><td>If light is burned out</td></tr>
<tr><td>With ignition switch on, apply 40-60 pounds of pedal force (15-20 pounds for power-assisted brakes), and observe light</td><td></td><td>If light comes on when brake pedal is depressed</td></tr>
<tr><td colspan="3">Many of today's cars have a combination of disc (caliper) type brakes on the front wheels and drum type brakes on the rear wheels. On vehicles equipped with disc brakes, some drag can be felt when turning the wheel and tire. This drag is <u>NOT</u> excessive if the wheel can be turned readily with both hands.</td></tr>
</table>

Procedure	Equipment	Reject Vehicle
G. Brake Drums - Inspect condition of drum friction surface for substantial cracks extending to open edge of drum (short hairline heat check cracks should not be considered)		G. If there are substantial cracks on friction surface extending to open edge
Inspect for cracks on outside of the drum		If there are external cracks
Inspect for mechanical damage		If there is evidence of mechanical damage, other than wear
Inspect for contaminated friction surface		If friction surface is contaminated with oil, grease, or brake fluid
Measure inside diameter of drum		If brake drums have been remachined beyond tne following specifications: Small diameter drums up to 14 inches in diameter not to be worn or machined beyond 0.060 inch in diameter or 0.030 inch on a side Large diameter drums 14 inches and over not to be machined beyond 0.090 inch and not to be worn beyond 0.120 inch
H. Brake Discs - Inspect for substantial cracks extending to edge of disc		H. If there are substantial cracks extending to edge
Inspect for mechanical damage		If there is evidence of mechanical damage other than wear
Measure thickness of disc		If disc brake pad thickness does not conform to the following manufacturers' specifications:

<table>
<tr><th>Procedure</th><th>Equipment</th><th>Reject Vehicle</th></tr>
<tr><td></td><td></td><td><table>
<tr><th>Make</th><th>Disc Brake Pad</th></tr>
<tr><td>American Motors</td><td>1/16"</td></tr>
<tr><td>Chrysler Corp.</td><td>1/32"</td></tr>
<tr><td>Ford Motor Co.</td><td>1/32"</td></tr>
<tr><td>General Motors</td><td>1/32"</td></tr>
<tr><td>Studebaker</td><td>1/4" (incl. shoe)</td></tr>
<tr><td>All Foreign and Sports Cars</td><td>Replacement thickness according to factory specifications</td></tr>
</table></td></tr>
<tr><td>I. Vacuum System -</td><td></td><td>I. Reject as follows:</td></tr>
<tr><td>1. Condition of - Inspect system visually for collapsed, broken, badly chafed and improperly supported hoses and tubes, and for loose or broken hose clamps</td><td></td><td>1. If hoses or tubes are leaking, or are collapsed, broken, badly chafed, improperly supported, or loose because of broken clamps</td></tr>
<tr><td>2. Operation of - Determine if system is operating by first stopping engine; then depress brake pedal several times to destroy all vacuum in system; then depress pedal with a light force; while maintaining this force on pedal, start engine and observe if pedal moves slightly when engine starts</td><td></td><td>2. If service brake pedal does not move slightly as engine is started while pressure is maintained on pedal</td></tr>
</table>

PARKING BRAKE INSPECTION - Parking brakes on most U.S. vehicles function through at least one set of the rear service brake shoes. A few U.S. vehicles have disc type service brakes on all four wheels, which make it necessary to have separate drums for the parking brakes. These drums and linings should be inspected in a manner similar to that for service brakes. Any parking brake should hold a stopped vehicle firmly on all normal road gradients.

Procedure	Equipment	Reject Vehicle
J. Parking Brake Function - Set parking brake firmly to determine reserve travel of hand lever or foot pedal Hand brakes must be capable of holding any loaded vehicle or combination of loaded vehicles on any grade upon which it is operated		J. If there is no reserve travel in the lever (or pedal) If hand/parking brake will not hold vehicle when operated in second gear (or "drive" if automatic transmission)

SECTION IV

LIGHTING AND ELECTRICAL SYSTEM

Preparation for headlamp and aim inspection is to be done by the owner of the vehicle prior to inspection

ANY ONE of the items listed below can affect the inspection results, causing rejection of the vehicle. To prevent this, the four items listed in procedure A should be checked prior to inspection.

Procedure	Equipment	Reject Vehicle
A. Prior to Inspection - 1. Remove excessive ice and mud from under fenders 2. Inflate tires to specified pressures 3. See that vehicle contains no load other than driver in his normal position 4. Be sure that lenses are clean; check for burned-out bulbs and proper beam switching; replace headlamps with cracked or broken aiming pads		A. If any one of these items are not accomplished to a reasonable degree, thereby making a good inspection difficult (inspector should refuse vehicle until preparation is satisfactory)

GENERAL LAMP AND REFLECTOR INSPECTION - This includes all original equipment exterior lighting plus whatever lights have been added. If a vehicle is equipped with a light, it should work properly.

See ADDITIONAL LIGHTING INFORMATION. Definitions: Page A-25 -- SAE Coding: Page A-30

B. Lamp Function - Turn on night-driving lights and visually check the following (check 1 and 2 with ignition switch "on"):	Large mirrors may be placed so that all lamps may be observed from driver's position	B. If any bulb or sealed beam unit fails to light

Procedure	Equipment	Reject Vehicle
1. Actuate turn signal lever to right and left and observe function of turn signal lights (1958 vehicles or later)		1. If turn signals do not properly indicate right and left when so switched
2. Place vehicle in reverse gear and check backup lamps (if car is so equipped)		2. If backup light system does not turn off automatically when vehicle goes forward
3. If car is so equipped, actuate the following and observe lamps: Hazard warning lamps Brake warning lamps Indicator lamps Stop lamps Headlamps - upper and lower beam (see Procedure C)		3. If lamp shows color contrary to law If lamp fails to light proper filament indicated at switch position If any lamp or reflector does not direct light properly If auxiliary equipment is placed on, in, or in front of any lamp If lamp assembly is improperly fastened If lamp has a cracked, broken, or missing lens
4. Observe function of: Tail lamps Parking lamps Side marker lamps Reflex reflectors Clearance lamps Identification lamps Emergency warning lamps All others		

HEADLAMPS - The vehicle must be located on a level area and loaded as it is normally driven with the driver behind the wheel. U.S. headlamps (see Figure 15) are always "sealed beam" and come in two sizes:

5-3/4-inch-diameter DUAL upper beam, Type 1, and lower beam, Type 2.
7-inch-diameter SINGLE - both upper and lower beam (most 7-inch lamps are Type 2 only).

Procedure	Equipment	Reject Vehicle
C. Headlamps -	Photo-optical headlamp testing machine	C. Reject as follows:
1. Driving or High Beam - Check in accordance with tester's instructions (this includes single-beam 5-3/4-inch-diameter Type 1 lamps and older 7-inch-diameter dual-filament lamps which do not have a figure 2 molded in the lens near the top)		1. If horizontal aim is more than 6 inches to the left or 6 inches to the right If vertical aim is higher than 4 inches up or lower than 4 inches down If candlepower is less than 10,000
2. Passing or Low Beam and Fog Lights - Check in accordance with tester's instructions (this includes dual-filament 5-3/4-inch-diameter Type 2 lamps and dual-filament 7-inch-diameter Type 2 lamps; all headlights in this class have figure 2 molded in lens near top)		2. If horizontal aim is more than 15 inches to the left or 21 inches to the right If vertical aim is higher than 9 inches up or lower than 13 inches down If candlepower is less than 7,000

To save time, the inspector should develop his own plan or sequence for checking miscellaneous electrical items, many of which can be inspected while looking at other items. This comes with practice.

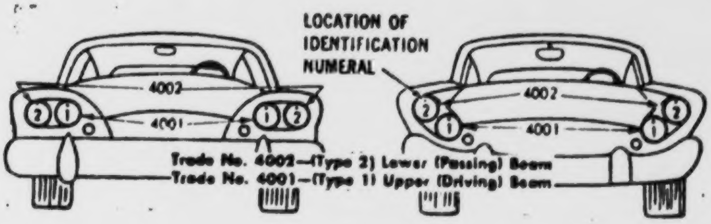

LOCATION OF IDENTIFICATION NUMERAL
4002
4001
2
1
Trade No. 4002—(Type 2) Lower (Passing) Beam
Trade No. 4001—(Type 1) Upper (Driving) Beam

Figure 15

Procedure	Equipment	Reject Vehicle
D. Electrical System -		D. Reject as follows:
1. Horn - Should be securely fastened		1. If horn is loose or fails to function
2. Switches - Should all function properly		2. If switches fail to function or turn signal switch fails to cancel (if so designed)
3. Wiring - Should be well insulated		3. Wiring insulation is worn, rubbed bare, or shows any evidence of burning or short-circuiting

ADDITIONAL LIGHTING INFORMATION - PASSENGER CARS

Definitions

A. Sealed Beam Headlamp Assembly

A sealed beam headlamp assembly is a major lighting device used to provide general illumination ahead of the vehicle. It consists of the following:

1. One or more sealed beam units (bulb assembly).
2. Means for mounting securely to the vehicle.
3. Means to permit required aim adjustment.

B. Sealed Beam Unit

An integral and hermetically sealed optical assembly with the name "Sealed Beam" molded in the lens.

C. Headlamp Upper Beam

A distribution of light intended primarily for distant illumination and for use on the open highway when not meeting other vehicles.

D. Headlamp Lower Beam

A distribution of light so directed as to avoid glare in the eyes of oncoming drivers while providing illumination ahead of the vehicle and intended for use in congested areas and on highways when meeting other vehicles within a distance of 500 feet.

E. 7-Inch Sealed Beam Unit

1. A sealed unit 7 inches in diameter providing an upper and a lower beam. Two similar units are used on a vehicle. This unit is identified by a number "2" on the lens and is aimed on the lower beam.

2. 7-Inch Sealed Beam Unit (no identifying number on lens) - A sealed unit 7 inches in diameter providing an upper and lower beam. Two similar units are used on a vehicle. This is an obsolete unit no longer being installed in production. It should be aimed on the upper beam.

F. 5-3/4-Inch Type 1 Sealed Beam Unit

A sealed unit 5-3/4 inches in diameter having a single filament and providing only an upper beam distribution of light.

G. 5-3/4-Inch Type 2 Sealed Beam Unit

A sealed unit 5-3/4 inches in diameter having two filaments, one filament providing the lower beam and one filament providing fill-in light for the upper beam. It is aimed on the lower beam.

H. Symmetrical Beam

A symmetrical beam is one in which both sides are symmetrical with respect to the median vertical plane of the beam. Lamps having symmetrical beams are:

1. 5-3/4-inch Type 1

2. 5-3/4-inch Type 2 (upper beam filament)
3. All 7-inch units (upper beam filament).

I. Asymmetrical Beam (Nonsymmetrical)

An asymmetrical beam is one in which both sides are not symmetrical with respect to the median vertical plane of the beam. All lower beams are asymmetrical.

J. Fog Lamps

Fog lamps are lamps which may be used with or in lieu of the lower beam headlights to provide illumination under conditions of rain, snow, dust, or fog.

K. Tail Lamps

Tail lamps are lamps used to designate the rear of a vehicle.

L. Stop Lamps

Stop lamps are lamps giving a steady warning light to the rear of a vehicle, to indicate the intention of the operator of the vehicle to reduce speed or stop.

M. License Plate Lamps

License plate lamps are lamps used to illuminate the license plate on the rear of a vehicle.

N. Parking Lamps

Parking lamps are lamps used to designate the front of a parked vehicle.

O. Side Marker Lamps

Side marker lamps are lamps on the left and right sides, beamed to the side, intended to indicate vehicle length. They are located near the front and rear on each side, and for vehicles over 30 feet in length, are also located at the midpoint (intermediate side marker).

P. Backup Lamps

Backup lamps are lamps used to provide illumination behind the vehicle, and to provide a warning signal when the vehicle is in reverse gear.

Q. Turn Signal Lamps

Turn signal lamps are lamps which provide a flashing warning light to indicate the intended direction of the turn.

R. Emergency Warning Lamps

Emergency warning lamps are lamps which provide a flashing light to identify an authorized vehicle on an emergency mission. The emergency signal may be either a rotating beacon or pairs of alternately or simultaneously flashing lamps.

S. Hazard Warning Lamps

Hazard warning lamps are turn signal lamps which flash simultaneously to warn of the presence of a vehicular hazard.

T. Reflective Devices

Reflective devices are devices used on vehicles to give an indication to an approaching driver by reflected light from the headlamps of approaching vehicles.

U. Indicator Lamps

Indicator lamps are lamps visible to the operator of a vehicle that indicate:

1. Appropriate electrical circuits are in operation
2. Malfunction of vehicle performance
3. Requirement for remedial action by the operator of the vehicle.

V. Operating Units or Switches

Operating units or switches are devices by which the functioning of lamps are controlled.

W. Lane Changer

A lane changer is a device, usually incorporated in the turn signal switch which will actuate the turn signal lamps when held by the driver. It is intended for momentary use for signaling a lane change. When released by the operator, it will return to neutral and deactivate the signal lamp.

X. SAE Lighting Identification Code

The SAE lighting identification code is a series of standardized markings for lighting devices which a manufacturer or a supplier may use to mark his product to indicate the SAE Lighting Standard or Standards to which the device is designed to conform. The code is not intended to limit the manufacturer or supplier in applying other markings to the devices.

Y. Cornering Lamps

Cornering lamps are steadily burning lamps used when the turn signal system is operating to supplement the headlamps by providing additional road illumination in the direction of the turn.

Z. Driving Lamp

An auxiliary lamp or lamps that may be used to supplement the upper beam of the regular headlamps.

AA. Passing Lamp

An auxiliary lamp or lamps that may be used to supplement the low beam of a standard headlamp system. It is not intended for winding roads or congested city areas.

SAE Lighting Identification Code

Following is a list of identifying codes for lights and signaling devices:

Device	SAE Identification Code Designation
Reflex Reflectors:	
Class A	A
Class B (used prior to 1969 only)	B
Turn Signal Lamps:	
Class A	I
Class B	D
Side Turn Signal Lamps	E
Fog Lamps	F
Headlamp Housing	H
Cornering Lamps	K
License Plate Lamps	L
Motorcycle Headlamps (Motorcycle Type)	M
Motorcycle Headlamps (Motor Driven Cycles)	N
Spot Lamps	O
Identification or Parking Lamps	P
Clearance or Side Marker Lamps	P1
Combination Clearance and Side Marker Lamps	PC
Turn Signal Operating Units:	
Class A	Q
Class B	QB
Vehicle Hazard Warning Signal Operating Unit	QC
Back Up Lamps	R
Stop Lamps	S
Tail Lamps	T
Liquid Burning Emergency Flares	V
Warning Lamps, Emergency and Service Vehicles	W1
Warning Lamps School Buses	W2
Warning Lamps 360 Degree Emergency	W3
Emergency Electric Lanterns	X
Driving Lamps	Y
Passing Lamps	Z

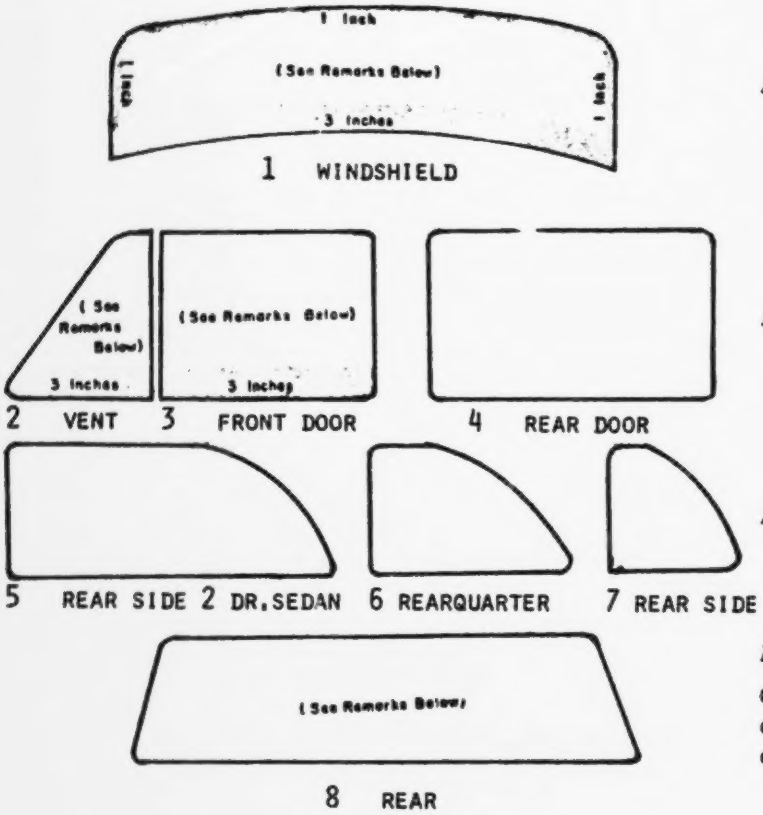
SECTION V

VEHICLE GLAZING

Automotive safety glazing is marked with the manufacturer's trademark and the letters "AS" followed by a number from 1 through 11. Only AS1 (or AS10 - Bullet Resistant) may be used in the windshield. Safety glazing for 1966 and later models also has a glass manufacturer's model number or a DOT code number.

See Figure 16 for position numbers, discoloration areas, and markings.

Procedure	Equipment	Reject Vehicle
A. Proper Markings - Inspect glass for proper markings		A. If improper or unmarked glazing materials are used for specific positions Nontransparent materials such as plywood, etc., are used to replace glass
B. Left Front Window - Inspect operation of window at driver's left; window must open readily even though vehicle has approved turn signals		B. If window at driver's left cannot be readily opened to permit arm signals
C. Stickers, Tinting - Windshield and other glass shall be clear of posters, stickers, or other nontransparent materials except as allowed by law or identification decals or stickers used for admission to or parking in restricted areas; these should not interfere with driver's vision and if placed on the windshield, must be in lower righthand corner or on top of windshield behind the rear view mirror if vehicle is so equipped		C. If glazed surfaces contain any stickers not permitted by law or regulation Unauthorized tinting or nontransparent material has been used


1 inch
(See Remarks Below)
1 inch
1 inch
3 Inches
(See Remarks Below)
3 Inches
(See Remarks Below)
3 Inches
(See Remarks Below)

POSITIONS	MARKINGS**
1 WINDSHIELD	AS1 or 10*
2 VENT 3 FRONT DOOR 4 REAR DOOR	AS1, 2, 10*, or 11*
5 REAR SIDE 2 DR.SEDAN 6 REARQUARTER 7 REAR SIDE	AS1, 2, 10*, or 11*
8 REAR	AS1, 2, 10*, or 11* On soft top convertibles only AS1, 2, 4, 6, 10*, or 11*

REMARKS:

1-2-3 - Discoloration permitted as shaded diagram indicates.
1 - Star chips (stone nicks) larger than 1-1/2 inches in diameter at any location in the unshaded portion of the diagram should not be permitted.
1-2-3 - Any crack or separation that allows one piece of glass to be moved should not be permitted.
8 - Vision must be clear at least 200 feet to rear of vehicle.

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*Glazing marked AS10 or AS11 has bullet resisting qualities.
**Acceptable "AS" numbers in accordance with ANSI Glazing Standard Z26.1 - 1966.

Figure 16

Procedure	Equipment	Reject Vehicle
D. Cracks, Chips, or Discoloration - Inspect windshield and all windows for hazardous cracks, chips, sharp edges, and discoloration of glazing		D. If windshield has cracks or breaks which interfere with driver's vision, if cracked or broken in line with driver's vision, it must be replaced. If there is a crack longer than 3 inches in the windshield wiper arc on the driver's side If there is one "star" larger than 1 inch in diameter located in the area covered by the windshield wiper on the driver's side If there are three or more "stars" larger than 1 inch in diameter located in any area of the windshield, or any "star" larger than 3 inches in diameter located in any area of the windshield (excluding the area where cloudiness is permitted) If there are two or more cracks originating from the same or different points, two or more of which extend more than 8 inches in length each If there is cloudiness extending more than 1 inch from the top edge or extending more than 1 inch from the edge on the passenger's side, or more than 1 inch from the edge on the driver's side, or more than 3 inches from the bottom edge (tinting of approved tinted type safety class is not considered as "cloudiness")

SECTION VI

BODY AND SHEET METAL

Body components and sheet metal are subject to rejections if a condition exists which is hazardous to occupants, pedestrians, or other vehicles.

All vehicles manufactured after January 1, 1968, were equipped at the factory with a left-hand exterior rearview mirror. Rejections below marked with an asterisk (*) apply only to these vehicles.

Procedure	Equipment	Reject Vehicle
A. Exterior Rearview Mirror - From the driver's position, visually inspect exterior mirror on driver's side for a clear and reasonably unobstructed view to the rear; look for correct location, stable mounting, cracks, sharp edges, unnecessary protrusion, and ease of adjustment		A. If mirror is loose enough that rear vision could be impaired *If mirror is obscured by a pillar or unwiped portion of windshield *If mirror is mounted so that it cannot be adjusted from driver's seated position If mirror is cracked, pitted, or clouded to the extent that rear vision is obscured
B. Interior Rearview Mirror - From the driver's position, visually inspect interior mirror for proper mounting, location, cracks, sharp edges, and ease of adjustment		B. If mirror is loosely mounted If forward vision is unsafely obstructed by mirror assembly If mirror does not provide a clear view of highway at least 200 feet to rear If mirror is cracked, broken, has sharp edges, or cannot be cleaned, such that rear vision is obscured If mirror is very difficult to adjust or will not maintain a set adjustment

Procedure	Equipment	Reject Vehicle
Body exterior components and sheet metal parts if damaged and/or dislocated so that they project from the vehicle to present a safety hazard to occupants, pedestrians or other vehicles, may be cause for rejection of the vehicle.		
C. Protruding Metal - Inspect for torn metal parts, moldings, etc., which may protrude from vehicle		C. If torn metal, glass, or other loose or dislocated parts protrude from surface of vehicle causing a safety hazard to pedestrians or cyclists
D. Bumpers - Inspect bumpers for hazardous condition or unsafe mounting		D. If bumper is badly misplaced, loosely attached, or a broken or torn portion is protruding, creating a hazard
E. Fenders - Inspect for removal of front or rear fenders		E. If any fender has been removed
F. Doors - Inspect door latches, locks, hinges, and handles for proper operation, fastening, bad adjustment, or broken or missing components (try doors and locks)		F. If doors or door parts are missing, broken, or sagging so that door cannot be tightly closed
G. Hood - Open hood and inspect safety catch for proper operation; close hood and inspect for proper full closure; manually inspect latch or remote control for proper operation		G. If hood latch does not securely hold hood in its proper fully closed position If secondary or safety catch does not function properly If latch release mechanism or its parts are broken, missing, or badly adjusted so that hood cannot be opened and closed properly
H. Floor Pan - Inspect floor pan in both occupant compartment and trunk for rusted-out areas or holes which could permit entry of exhaust gases, or which would not support occupants adequately		H. If floor pan (front and/or rear) is rusted through sufficiently to cause a hazard to an occupant, or so that exhaust gases could enter either occupant compartment or trunk

Procedure	Equipment	Reject Vehicle
I. Seats and Seat Belts - Inspect seats for proper operation of adjusting mechanism and to see that seats are securely anchored to floor pan; inspect seat belts for frayed, split, or torn webbing, malfunctioning buckles, or loose or damaged anchorages or floor pan		I. If all seat anchor bolts are not securely fastened to floor or are missing If seat adjusting mechanism slips out of set position If belt buckles do not operate

WINDSHIELD WIPERS - U.S. vehicles produced after January 1, 1968, must be equipped with wiper systems capable of operating at two or more speeds. A "cycle" shall consist of blade movement from one extreme of the wiper pattern to the other and return.

J. Windshield Wipers - Inspect for satisfactory operation (if vacuum operated, engine must be idling and control full on); windshield must be free of bugs, oil film, or other foreign matter, and must be continuously wet when tested		J. If wipers do not operate at a minimum speed of 45 cycles per minute If vehicles produced after Jan. 1, 1968 do not have two or more speed systems If blades smear or severely streak windshield after 5 cycles
Inspect for damaged, torn, or hardened rubber elements of blades		If blades show signs of physical breakdown of rubber wiping element
Inspect for damaged metal parts of wiper blades or arms		If parts of blades or arms are missing or are damaged
K. Sun Visors - Inspect sun visors for broken, bent, or loose parts which prevent the visors from being positioned, or for visors which will not stay in a set position		K. If driver visor is missing or will not stay in a set position

<table>
<tr><th>Procedure</th><th>Equipment</th><th>Reject Vehicle</th></tr>
<tr><td colspan="3">WINDSHIELD DEFROSTER - It is very important that the defroster be given a minimum check as shown. Vehicles produced after January 1, 1968, must be equipped with windshield defroster systems.</td></tr>
<tr><td>L. Windshield Defroster - Turn on windshield defroster fan switch to "high" blower speed and inspect for heated air blowing over inside of windshield, covering areas directly in front of driver and front seat passenger (engine must be warm and all elements of defroster system must be "on")</td><td></td><td>L. If defroster fan fails to function
If fan functions but a stream of air cannot be "felt" blowing against proper area of windshield</td></tr>
</table>

SECTION VII

EXHAUST AND FUEL SYSTEM

The exhaust system includes the piping leading from the flange of the exhaust manifold to and including the mufflers, resonators, and the tail piping.

Procedure	Equipment	Reject Vehicle
A. Exhaust System - Visually examine mufflers, resonators, tail pipes, exhaust pipes, and supporting hardware while vehicle is on a hoist or over a pit; check muffler for leakage by momentarily restricting flow at tail pipe; rusted or corroded surfaces should be given particular attention (holes in system made by manufacturer for drainage are not cause for rejection); all gasoline powered vehicles manufactured in the U.S. after July 1, 1965 and all other motor vehicles equipped with crankcase ventilation systems shall be inspected for proper operation	Hoist	A. If vehicle has no muffler If there are loose or leaking joints If there are holes, leaking seams, or patches on muffler If tail pipe end is pinched If elements of system are not securely fastened If there is a muffler cutout or similar device that allows excessive noise or emits a higher noise level than original equipment If any part of system passes through occupant compartment If crankcase ventilating system is missing or inoperative If exhaust gases are discharged in area between ground and outer body lines If flexible tubing is used other than original equipment or a replacement equal to

The fuel system includes the fuel tank, fuel pump, and necessary piping to carry the fuel from the tank to the carburetor.

Procedure	Equipment	Reject Vehicle
B. Fuel System - Visually examine fuel tank, fuel tank support straps, filler tube (rubber, plastic, metal), tube clamps, fuel tank vent hoses or tubes, filler housing drain, overflow tubes, and filler cap		B. If any part of the system is not securely fastened If there is fuel leakage at any point in the system If fuel tank filler cap is missing If there is physical damage caused by aging

APPENDIX C

INSPECTION TASK TIME ANALYSIS

APPENDIX C

INSPECTION TASK TIME ANALYSIS

The following inspection time estimates are based on the results of inspection lane observation, discussions with lane operators and equipment manufacturers, time-motion studies, and analysis of existing documents and previous studies. Thus, the time estimates represent the consensus of several inputs. Listed below is a typical sequence of inspection tasks, not all of which would be performed because of the various options available.

- Vehicle Receiving Function

Check vehicle registration data	10 seconds
Check license plates	10
	20

- Brakes — Dynamic Road Test

Enter vehicle, drive to road test area	10 seconds
Accelerate, hold at 20 mph	5
Perform brake test	5
Check brake travel and reserve	5
Check failure indicator and pedal effort	5
Stop engine and check power assist	10
Restart engine, check emergency brake	5
Release brake, advance to lift	10
	55

- Brakes — Dynamic Roller Test

Enter vehicle, advance front wheel over rolls	10	seconds
Start rollers, test front brakes	30	
Stop rollers, advance vehicle	5	
Start rollers, test rear brakes	30	
Check brake travel and reserve	5	
Stop engine, check power assist	5	
Restart engine, check emergency brake	5	
Advance vehicle	10	
	100	

- Brakes — Dynamic Platform Test

Enter vehicle, advance vehicle	10	seconds
Apply brakes upon approaching platform	2	
Note front and rear recordings	2	
Advance vehicle to next test area	10	
Check brake travel and reserve	5	
Stop engine, check power assist	5	
Restart engine, check emergency	5	
Advance vehicle	10	
	49	

- Brakes — Static Inspection

Advance vehicle over lift	10	seconds
Raise vehicle or specific front wheel	5	
Remove wheel and drum	30	
Inspect drum, note wear	3	
Inspect lining or disc pad	3	
Inspect wheel cylinder	3	
Check brake lines and fittings	5	
Replace wheel and drum, adjust wheel bearing	30	
	89	

Remove rear wheel and drum	45	seconds
Inspect same as front brakes	15	
Replace rear wheel and drum	30	
	90	

- Headlight Alignment

Position headlight tester	10 seconds
Check headlight alignment and operation	15
Remove tester, position on other lamp	15
Check headlight alignment and operation	15
Remove headlight tester	5
	50

- Lighting and Electrical

Check taillights illuminated	3 seconds
Check turn signals, parking lights	3
Check flasher operation	2
Check brake lights	2
Check back-up lights, license lights	3
Check horn	2
	15

- Glazing

Check windshield	3 seconds
Check windshield operation	3
Check rear view mirrors	3
	9

- Exterior Body

Check bumpers and fenders	5 seconds
Check doors and locks	5
Check side and rear reflector lenses	5
	15 seconds

- Engine Compartment

Unlatch hood, check safety release, open	5 seconds
Check belts, water and heater hoses, clamps	3
Check power steering fluid, hoses	3
Check brake master cylinder, lines, fittings	3
Check steering column	2
Close hood	2
	18

- Steering System — Interior

Enter vehicle, note steering wheel diameter	2	seconds
Pick arbitrary wheel point, turn wheel from stop-to-stop	3	
Check for excessive lash or free play	3	
Check for jamming or binding	3	
	11	

- Steering System — Exterior

Advance vehicle over lift	5	seconds
Raise vehicle to load ball joint	5	
Grasp front tire, check linkage play	3	
Check ball joint seals	3	
Check stabilizer bars	3	
Check front shocks for leakage, worn bushings	3	
Check radius rods for damage	3	
Lower vehicle	5	
	30	

- Exhaust System, Brake Lines, Fuel Lines

Enter vehicle, start engine	5	seconds
Check muffler for loudness	2	
Advance over lift	3	
Raise vehicle	5	
Check muffler, resonator, pipes, clamps	15	
Check brake lines and fittings	5	
Check fuel lines and fittings	5	
Lower vehicles	5	
	45	

- Tires and Wheels Assemblies

While vehicle on lift, check tires for:		
Match, correct size	5	seconds
Tread depth	5	
General conditions	5	
Check wheel assemblies for:		
Retention or mounting	30	
Runout or deformation each wheel	30	
Check alignment on scuff gauge	3	
	78	

- Vehicle Certification Function

Complete inspection form	60	seconds
Inform owner of deficiencies if any	10	
Remove old sticker	10	
Affix new sticker	5	
	85	

APPENDIX D

RECOMMENDED SAFETY INSPECTION EQUIPMENT LIST

APPENDIX D

RECOMMENDED SAFETY INSPECTION EQUIPMENT LIST

The following list was developed as a result of an evaluation and analysis of the Colorado inspection standards and other reports on vehicle safety inspection. This contracted study with the Colorado Motor Vehicle Division is documented in "Motor Vehicle Safety Inspection Program Study" prepared by Olson Laboratories, Inc., dated 15 November 1972.

A station must have the following equipment and tools to qualify for a state permit:
Aimer, headlamp, photo-optical
Air chuck
Air compressor
Air hose
Ballpoint pen
Blow gun
Brake bleeding equipment
Brake cylinder hone set
Clamps, brake cylinder, hydraulic (6)
Cold chisels
Creeper
Cutter, diagonal
Cutter, tubing
Dial indicator, w/swivel and stand
Drop light
Electric drill w/bits

Equipment and Tools List (Continued)

Floor stands (4)
Grease gun
Gauge, scuff, drives-over
Gauge, pedal pressure
Gauge, tire pressure
Gauge, tire tread depth
Hammer, 2-pound
Hammer, 8-ounce
Hammer, rubber
Jack, heavy duty
  or two-ton, floor
  or chassis lift
Light tester or volt-ohm meter
Micrometer, brake drum
Parts cleaning facilities
Pliers, brake spring
Pliers, vise grip
Screwdrivers, Phillips set
Screwdrivers, slot set
Soldering iron
Socket set, 1/2" drive, 7/16 to 1-1/4
Spreader fork, drag link and shock arm
Steel tape
Stop watch
Vise, bench, 4-1/2" jaw
Wheel puller
Wire brush
Workbench
Wrenches, brake adjusting
Wrenches, Allen set

APPENDIX E

PROGRAM COST SUMMARY FOR VEHICLE EMISSION INSPECTION

APPENDIX E

PROGRAM COST SUMMARY FOR VEHICLE EMISSION INSPECTION

The following cost data were extracted from the State of Colorado, Department of Health study, "Vehicle Emission Inspection and Control Program," as prepared by Olson Laboratories. For details relative to the cost model, cost elements, data inputs, assumptions and conditions of the total study, the reader should refer to the cited reference (Ref. 5).

Table E-1. FACILITIES

Region	Alternatives					
	Privately Operated		State Operated[a]			
	Idle	Key Mode	Idle		Key Mode	
I	59	78	3F	5M	8F	3M
II	316	418	35F	3M	42F	3M
III	20	25		3M		4M
IV	95	128	9F	3M	11F	4M
V	11	12		2M		2M
VI	11	13		2M		2M
VII	40	53	1F	4M	2F	4M
VIII	9	10		1M		2M
Total	561	737	48F	23M	63F	34M

[a] F for fixed facility.
M for mobile unit.

Table E-2. PERSONNEL

Description	State Salary	Privately Operated		State Operated	
		Idle	Key Mode	Idle	Key Mode
Program Manager	$19,800	1	1	1	1
Regional Manager, Safety Supervisor	14,800	3	3	4	4
Executive Secretary	8,800	1	1	1	1
Clerk/Secretary	6,800	8	8	10	10
Public Relations Specialist	14,100	1	1	1	1
Training and Certification Specialist	14,100	1	1	1	1
Technical Support Specialist	14,800	3	3	3	3
Instructor	11,200	0	0	1	1
Facility Compliance	11,200	22	30	4	4
Instrumentation Technician	9,300	2	3	6	6
Lead Test Technician	9,300	0	0	71	87
Facility Supervisor	9,300	0	0	4	5
Test Technician	6,200	0	0	71	87
Clerk/Data Recorder	5,200	8	11	6	8

Table E-3. INITIAL INVESTMENT

Major Costs	Privately Operated		State Operated	
	Idle	Key Mode	Idle	Key Mode
Site Acquisition	$ -0-	$ -0-	$ 382,156	$ 425,728
Facility Construction	-0-	-0-	787,992	1,326,620
Inspection Equipment	6,997,914	14,793,064	797,666	1,308,663
Facility Certification	75,125	99,934	29,621	30,655
Personnel Training	22,137	27,603	66,122	131,564
Administrative Support	200,741	222,641	108,177	109,665
Total	$7,295,915	$15,143,241	$2,171,734	$3,332,895

Table E-4. ANNUAL OPERATION

Major Costs	Privately Operated		State Operated	
	Idle	Key Mode	Idle	Key Mode
Inspection Personnel	$ -0-	$ -0-	$1,291,381	$1,562,060
Station Administrative Personnel	-0-	-0-	74,214	141,592
Inspection Equipment Maintenance	699,791	1,479,303	79,766	130,866
Supplies and Equipment	1,902,570	3,195,917	203,392	296,174
Facility Maintenance	-0-	-0-	77,510	89,232
Facility Recertification	82,466	120,072	10,785	11,819
Personnel Training	3,677	4,771	12,992	26,467
Program Administration Support	647,932	784,131	427,881	433,592
Supplies and Equipment	-0-	-0-	9,600	12,600
Depreciation and Planned Expansion	-0-	-0-	38,650	65,331
Total	$3,336,434	$5,584,193	$2,226,068	$2,769,732

APPENDIX F

INTEGRATED SAFETY-EMISSIONS PROGRAM COST

APPENDIX F

INTEGRATED SAFETY-EMISSIONS PROGRAM COST

The following cost analysis derives and uses the information, data, and cost estimates recorded in two studies performed for the State of Colorado that were completed in 1972. The "Vehicle Emission Inspection and Control Program" study was contracted with the Department of Health, Air Pollution Control Division, and the "Motor Vehicle Safety Inspection Program" study was contracted with the Department of Revenue, Motor Vehicle Division.

F.1 STATE OPERATED EMISSIONS – SAFETY INSPECTION FACILITY

Assumptions:

- Idle emissions inspection only
- Safety-related inspection only
- No on-line station adjustments, repair, service
- Estimated vehicle throughput – 15 minutes
- Estimated lane output – one vehicle every 5 minutes
- Automated data retrieval and processing
- Lane capacity – 12 vehicles per hour maximum

- Facility capacity — minimum of two lanes, maximum of four lanes, per State site
- Lane efficiency — 60 percent (accounting for equipment downtime, vehicle scheduling)
- Inspection period — open 8 working hours per day, 5 days per week, 50 weeks per year
- Expected lane capacity — 14,400 vehicles per year

  $$0.6\left(12\ \frac{\text{vehicles}}{\text{hour}} \times 8\ \frac{\text{hours}}{\text{day}} \times 5\ \frac{\text{days}}{\text{week}} \times 50\ \frac{\text{weeks}}{\text{year}}\right)$$

F.1.1 Lanes Required

If an annual inspection is used then capability must be provided for 1.69 million vehicles. However, if twice-a-year inspection is anticipated, then capability must be 3.38 million vehicles. These figures are derived from the following calculation:

$$\begin{aligned}\text{1.3 million vehicles} + \text{30 percent retests} &= (1.3)(1.3)(10^6)\\ &= (1.69)(10^6)\ \text{vehicles}\end{aligned}$$

The number of inspection lanes required then would be:

$$\text{Once-a-year inspection, } \frac{1{,}690{,}000}{14{,}400} = 117 \text{ lanes}$$

$$\text{Twice-a-year inspection, } \frac{3{,}380{,}000}{14{,}400} = 334 \text{ lanes}$$

The number of lanes required may be decreased by scheduling longer operating hours (e.g., 12 hours instead of 8 hours) and also by remaining open more days per week (e.g., 6 or 7 days per week instead of 5 days). These alternatives may be considered in the future because a complex trade off is involved including investment costs for buildings, sites, and equipment; versus operating costs for inspection personnel, building upkeep, and equipment utilization; versus the time, distance traveled, and other convenience factors of the motorist. These considerations would be far beyond the contracted scope of this study.

F.1.2 Facility and Site Requirements

In order to service the entire State, 66 fixed-site facilities and 23 mobile units will be required (see Table F-1). Each fixed site will consist of a double-lane configuration with sufficient acreage for a building, traffic control, and staff parking. Each mobile unit will be completely equipped for safety and emissions testing plus data recording and administrative functions. A mobile unit is equivalent to a single-lane configuration.

Table F-1. FACILITY AND SITE REQUIREMENTS

Region	Fixed Facility	Mobile Unit
I	4	5
II	48	3
III	1	3
IV	12	3
V	0	2
VI	0	2
VII	1	4
VIII	0	1
Total	66	23

The calculated facility capacity is:

Fixed Site = (66)(2) = 132 lanes equivalent
Mobile Units = (23)(1) = 23 lanes equivalent
155 lanes

Each lane = 14,400 vehicles per year

Then total capacity = 14,400 x 155 = 2,232,000 vehicles. Recall previously that capacity was estimated at 60 percent efficiency. Consequently, the theoretical maximum would be 3.7 million vehicles per year, or sufficient facilities to provide twice-a-year inspection with 30 percent reinspection.

F.1.3 Site Acquisition and Facility Construction

- Each site has acreage of 15,000 square feet.
  Site acquisition = $1 per square foot
  Site preparation = $1 per square foot
  Total cost = $2 per square foot
  (66 sites)(15,000 sq.ft.)($2) = $1,980,000

- Each facility has 4,000 square feet.
  Facility construction = $12 per square foot
  Total cost = (66)(4,000)($12) = $3,168,000

F.1.4 Inspection Equipment

Each two-lane configuration includes all of the equipment needed to perform vehicle safety inspections (see Appendix D), vehicle Idle emission testing, and data processing.

- Two lane configuration = $54,270 installed.
  (66 sites)($54,270) = $3,581,985

- One mobile unit = $80,000
  (23 units)($80,000) = $1,840,000

- Total equipment cost = $3,581,995 + $1,840,000
  = $5,421,985

F.1.5 Facility Certification

- One day per facility involving one team of two certifiers

- Travel time between facilities = 1 day

- Per diem on travel status = $25 per day

- Recertification quarterly

- Initial certification
  (66 sites)(1 day) = 66 days
  (23 mobile units)(1 day) = 23 days
  66 work days = 14 weeks = 28 man weeks
  = 196 travel days
  23 days for mobile units
  = no travel charges, unit tested at "home"
  Per diem = (196)($25) = $4,900
  One certification van = $15,000
  Total certification cost = $19,900
  One-half of a man year = $5,000

- Recertification quarterly
  Per diem cost = $4,900
  Equipment cost = $500

Van upkeep = 10,000 miles x 0.12 = $1,200
Quarterly cost = $6,600
Annual cost = $26,400

F.1.6 Initial Training Personnel

- Two lane configuration

Receiving inspector	1
Lane inspectors	6
Certification inspector	1
Supervisor	1
Administration	1
Total	10

- Mobile unit — two inspectors

- Training periods — 80 hours, 10 working days

- Manpower expended
  (66)(10) + (23)(2) = 660 + 46 = 706 inspectors
  (706)(10 days) = 7,060 man days

- Technician pay range — $6,200 to $9,300
  Assume average of $8,000 per year
  Fringe benefits of 30 percent
  Typical technican cost = (1.3)($8,000) = $10,400 per year
  Man days per year = 260

- Training cost = $\frac{7,060}{260}$ x $10,400 = $282,400

F.1.7 On-Going Training

- Assume 20 percent annual turnover
- New training of replacements = (0.25)($282,400)
- Annual training = $70,600

F.1.8 Program Administration

Table F-2 gives a breakdown of the costs for administration of the program.

Table F-2. PROGRAM ADMINISTRATION COSTS

	Salary	Cost
Program Manager	$19,800	$ 19,800
Regional Manager	14,800	59,200
Public Relations	14,100	14,100
Training and Certification	14,100	14,100
Technical Support	14,800	44,400
Training Instructor	11,200	11,200
Certification Inspectors	11,200	33,600
Instrumentation Technician	9,300	55,800
General Clerks/Secretary	6,800	476,000
Executive Secretary	8,800	44,000
Total Annual Salary		$ 772,200
Fringe Benefit 30 percent		231,700
Total Annual Cost		$1,003,900

F.1.9 Initial Investment Costs

Table F-3 shows the initial investment required to set up a test facility.

Table F-3. INITIAL INVESTMENT COSTS

Site Acquisition	$ 1,980,000
Facility Construction	3,168,000
Inspection Equipment	5,422,000
Facility Certification	24,900
Personnel Training, Initial	282,400
Administrative Support	165,700
Total	$11,043,000

F.1.10 Annual Operating Costs

Annual operating costs are shown in Table F-4.

Table F-4. ANNUAL OPERATING COSTS

Inspection Personnel — (706)($10,400)	$ 7,342,400
Inspection Equipment Maintenance	813,300
Supplies and Depreciation	406,600
Facility Maintenance	26,400
Facility Recertification	26,400
Personnel Training	70,600
Program Administration Support	1,003,900
Facility Depreciation and Expansion	158,400
Total	$ 9,848,000
Annual amortization of $11 million at 6 percent per year over 20 years	959,000
Total costs per year	$10,807,000
Allocated cost per vehicle per year	$8.30

F.2 PRIVATELY-OPERATED EMISSIONS-SAFETY INSPECTION FACILITY

Assumptions:

- Licensed stations currently exist to perform safety inspections
- Same stations will be licensed for Idle emissions inspections
- Vehicle emissions adjustments, service and repairs performed by mechanic of owner's choice
- Manual data recording and reporting to State Program Office
- Equipment available and operating on demand
- Inspection personnel available for testing vehicle without job interruption
- Inspectors receive same training as State inspectors — 80 working hours paid by station operator
- Existing labor rate is $10 per hour; $5 to inspector, $5 to station operator

F.2.1 Emission Equipment

Each station will purchase an HC/CO gas analyzer at $2,500. Equipment for data processing is negligible. Emission tune-up and servicing equipment normally are available in facilities. No additional units are recommended. Thus, the equipment required is only for exhaust analyzers.

The initial cost of $2,500 is amortized over 5 years at 6 percent, yielding an annual payment of $590. Assume an annual maintenance cost equal to 8 percent of equipment cost, or $200. Then the annual ownership cost is $790.

A station is assumed to remain open 10 hours per day, 6 days per week, 50 weeks per year. This is equivalent to 3,000 operating hours. It is recognized that the equipment will not be utilized full time. However, for analytical purposes, the allocated operating cost increases by $790/3,000 = $0.26 per hour for adding the emission inspection equipment.

F.2.2 Inspection Personnel

It was assumed in the State-operated alternative that each inspector receives 80 hours of training. Each facility would be required to have two technicians who are qualified for emission inspection. The direct labor charge is $5 per hour. Fringe benefits are assumed to equal 30 percent, as in the State-operated alternative. Thus the cost for training is:

$$(1.3)(\$5.00) = \$6.50 \text{ per hour.}$$

- Two men at 80 hours each = 160 man hours
- Total training cost to operator = (160)($6.50) = $1,040

Assuming that a technician remains with the initial station an average of 3 years, then the total hours per technician is (40)(50) = 2,000 hours per year, or 6,000 hours total. For two technicians, this is equivalent to 12,000 hours. Then the allocated cost to the stations is:

$$\frac{\$1,040}{12,000} = \$0.09 \text{ per hour.}$$

F.2.3 Labor Rate for Emission Inspection

Assuming that the current labor rate for vehicle tune-ups is \$10 per hour, and considering a pay-scale escalation of 5.5 percent annually, then by 1975, the new labor rate would be $(1.05)^2(\$10) = \$11.13$ per hour. By adding emission equipment and training, the labor rate becomes in 1975:

$$\$11.13 + 0.26 + 0.09 = \$11.48 \text{ per hour.}$$

F.2.4 Estimated Safety-Emissions Inspection Charges

From Appendix C and the Vehicle Emission Inspection study, the inspection task times shown in Table F-5 are derived.

Table F-5. INSPECTION TASK TIMES

Task	Time (minutes)
Vehicle registration check	1.5
Vehicle preparation	1.5
Vehicle safety inspection	9.0
Vehicle emission testing	5.0
Inspection data recording	2.0
Certification and results analysis	2.0
Total	21.0
Non-functional time (vehicle movement into, out of station)	2.0
Total	23.0

Using the estimated 1975 labor rate of \$11.50 per hour, the safety-emissions inspection charge would be:

$$\left(\frac{23}{60}\right) \$11.50 = \$4.40 \text{ per visit.}$$

This charge does not include State management expenses, such as the $0.25 sticker price currently charged.

F.2.5 State Program Management Expenses

The personnel necessary to administer the program are shown in Table E-6.

Table E-6. PROGRAM ADMINISTRATION PERSONNEL

Title	Annual Salary	Cost
Program Manager	$19,800	$ 19,800
Regional Manager	14,800	118,400
Public Relations	14,100	28,200
Training and Certification	14,100	14,100
Technical Support	14,800	44,400
Training Instructor	11,200	22,400
Certification Inspectors*	11,200	795,200
Instrumentation Specialist	9,300	158,100
General Clerks/Secretaries	6,800	54,400
Executive Secretary	8,800	70,400
Total Annual Cost		$1,325,400
Fringe Benefits — 30 percent		397,600
Total Program Cost		$1,723,000

*Certification inspectors:

- 4,200 stations inspected every quarter
- 65 working days per quarter
- 65 stations per day certified

- Each certification team inspects two stations per day
- Require 34 teams of 2 members each, or 68 inspectors
- Add 5 percent for absentees, or 71 inspectors required

A total of 1.3 million passenger vehicles are registered in the State. The annual allocated cost per registered vehicle then would be $1,723,000/1.3 million vehicles = $1.33 per vehicle per year.

F.2.6 Estimated Vehicle Inspection Fee

- For annual inspection,

  $4.40 + 1.33 = $5.73 per visit

- For semi-annual inspection,

  $4.40 + 0.67 = $5.07 per visit

The above charges by the privately-operated inspection station includes a labor charge of $4.40 per inspection plus the sticker charge of either $1.33 for annual inspection or $.67 for twice-a-year inspection.

APPENDIX G

EPA ADVISORY CIRCULAR ON HIGH ALTITUDE MODIFICATIONS

MSPC Advisory Circular

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR PROGRAMS • MOBILE SOURCE POLLUTION CONTROL PROGRAM

A/C No. 16 June 8, 1972 Page 1 of 3 pages

Subject: Approval of Emission Control Modifications for High Altitudes on New Motor Vehicles or Engines

A. Purpose

The purpose of this Advisory Circular is to explain the procedure whereby EPA will approve requests from manufacturers to modify new motor vehicles or engines to reduce emission levels at high altitudes.

B. Background

1. Recent studies have shown that emission-controlled vehicles and engines emit higher levels of pollutants at high altitudes than those same vehicles emit at low altitudes.

2. In many cases, emissions of certified vehicles and engines at higher altitudes can be significantly reduced through the use of modified calibrations in the fuel induction and ignition systems. However, the provisions of Section 203(a)(1) of the Clean Air Act make it a prohibited act for a manufacturer to distribute in commerce, sell, or offer for sale; or introduce, or deliver for introduction, into commerce; or import into the United States any new motor vehicle or motor vehicle engine unless the vehicle or engine is covered by a certificate of conformity. Thus, if a light duty vehicle or heavy duty engine manufacturer wished to modify the certified production vehicle or engine, in terms of any of the parameters listed in 40 CFR 85.89(a)(3), 40 CFR 85.89(b)(3), or 40 CFR 85.110(b)(3), the manufacturer would need to receive a determination from the Administrator that the vehicle would still be covered by the certificate of conformity then in effect.

3. If the vehicle has already been sold to an ultimate purchaser, Section 203(a)(3) of the Clean Air Act prohibits any manufacturer or dealer knowingly to remove or render inoperative any control device or element of design installed on or in the vehicle in compliance with regulations under Section 202 of the Act. Thus, manufacturers and dealers who modify the emission control system to reduce emission levels at high altitudes must first obtain a determination from the Administrator of EPA that such modification would not "render inoperative" the control system.

4. EPA encourages manufacturers to provide the vehicle owner an opportunity to have his vehicle modified so as to lower emission levels at high altitudes. This Advisory Circular explains the procedure for approving such modifications.

C. Applicability

The procedure described in this Advisory Circular covers requests from manufacturers to modify the emission control system of current model year production vehicles or engines which are intended for sale at high altitudes. Special carburetor calibrations and ignition timing changes would be examples of changes covered by the procedures described in this Advisory Circular. Upon obtaining EPA approval of the modification on production vehicles or engines, the manufacturers and dealers would be allowed to provide for the performance of these modifications as field fixes on current model year vehicles in the hands of the ultimate purchaser, as set forth in Advisory Circular No. 2.

D. Procedure

1. Requests for emission control modifications for use in high altitudes shall be submitted in accordance with 40 CFR 85.58. The testing to be required on high altitude modifications, in accordance with 40 CFR 85.58(b) is the following:

a. Fifty thousand mile Durability and four thousand mile Emission Data vehicles shall be run in those cases where the modification changes the engine-system combination of the certified vehicle or engine. Emission Data vehicles alone shall be run in those cases where the modification does not alter the configuration of the engine-system combination of the certified vehicle or engine. An example of a modification requiring Durability and Emission Data vehicle testing is the addition of an air pump. An example of a modification requiring only an Emission Data vehicle test is an alternate calibration.

b. Vehicles or engines equipped with a high altitude modification must be capable of demonstrating that they meet all applicable EPA emission control standards when tested at the EPA laboratory.

c. Manufacturers are encouraged to show, e.g. by results of tests conducted under high altitude conditions or by appropriate engineering data, what the effect of the modification is on vehicles or engines operating at high altitudes as compared to unmodified vehicles or engines of the same engine family at the same high altitude. Such data is useful to EPA in determining what impact high altitude modifications have on air quality.

d. The label prescribed under 40 CFR 85.4 shall indicate the engine tune-up specifications of the modified vehicle or engine for the high altitude for which the vehicle or engine is intended to be sold.

2. A suggested format for the application and a format for reporting data are attached to this Circular.

Eric O. Stork
Director
Mobile Source Pollution Control Program

Enclosure

APPENDIX H

EPA INTERIM TAMPERING ENFORCEMENT POLICY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Office of Enforcement and General Counsel

December 22, 1972

Mobile Source Enforcement Memorandum No. 1

Subject: Interim Tampering Enforcement Policy

A. Purpose

The purpose of this Memorandum is to state the interim policy of EPA with regard to enforcement of the "tampering" prohibition - Section 203(a)(3) - of the Clean Air Act.

1. Section 203(a)(3) of the Clean Air Act provides:

"The following acts and the causing thereof are prohibited -

> "(3) for any person to remove or render inoperative any device or element of design installed on or in a motor vehicle or motor vehicle engine in compliance with regulations under this title prior to its sale and delivery to the ultimate purchaser, or for any manufacturer or dealer knowingly to remove or render inoperative any such device or element of design after such sale and delivery to the ultimate purchaser."

Section 205 of the Act provides for a maximum civil penalty of $10,000 for any person who violates Section 203(a)(3).

2. This "tampering" provision of the law has created a great deal of uncertainty, primarily among new vehicle dealers and automotive aftermarket parts manufacturers, regarding what actions and/or use of what parts are prohibited. The terms "manufacturer" and "dealer" in §203(a)(3) refer only to motor vehicle manufacturers and new motor vehicle dealers; however, the law impacts indirectly on aftermarket parts manufacturers through its applicability to vehicle dealers who are customers for their products. Other provisions in the Act establishing manufacturer warranties and authorizing compulsory recall of properly maintained vehicles also have a potential for anti-competitive effects in the aftermarket.

3. In general, it is clear that EPA's primary objective in enforcing the statutory prohibition on "tampering" must be to assure unimpaired emission control of motor vehicles throughout their useful life. It is EPA's policy to attempt to achieve this objective without imposing unnecessary restraints on commerce in the automotive aftermarket.

4. The long range solution to minimizing possible anticompetitive effects that could result from implementation of these statutory provisions may lie in some type of certification program for at least certain categories of aftermarket parts. EPA is currently studying the technical, administrative and legal problems which such a program presents. EPA has yet to develop the policy, procedures, or facilities attendant to any long range solution.

5. In the absence of a long-term solution, and in the absence of proof that use of non-original equipment parts will adversely affect emissions, constraining dealers to the use of only original equipment parts would constitute an unwarranted burden on commerce in the automotive aftermarket. Pending development of a long range solution, the following statement reflects EPA's interim policy in the tampering area. This policy is intended to reduce the uncertainty which dealers now face by providing criteria by which dealers can determine in advance that certain of their acts do not constitute tampering.

B. Interim Policy

Unless and until otherwise stated, the Environmental Protection Agency will not regard the following acts, when performed by a dealer, to constitute violations of Section 203(a)(3) of the Act:

(1) Use of non-original equipment aftermarket part as a replacement part solely for purposes of maintenance according to the vehicle manufacturer's instructions, or for repair or replacement of a defective or worn out part, if the dealer has a reasonable basis for knowing that such use will not adversely affect emissions performance;

(2) Use of non-original equipment aftermarket part or system as an add-on, auxiliary, augmenting, or secondary part or system, if the dealer has a reasonable basis for knowing that such use will not adversely affect emissions performance; and

(3) Adjustments or alterations of a particular part or system parameter, if done for purposes of maintenance or repair according to the vehicle manufacturer's instructions, or if the dealer has a reasonable basis for knowing that such adjustment or alteration will not adversely affect emissions performance.

For purposes of clause (1), a reasonable basis for knowing that a given act will not adversely affect emissions performance exists if:

(a) the dealer reasonably believes that the replacement part is designed to perform the same function with respect to emission control as the replaced part, or

(b) the replacement part is represented in writing by the part manufacturer to perform the same function with respect to emission control as the replaced part;

For purposes of clauses (2) and (3), a reasonable basis for knowing that a given act will not adversely affect emissions performance exists if:

(a) the dealer knows of emissions tests which have been performed according to testing procedures prescribed in 40 CFR 85 showing that the act does not cause similar vehicles or engines to fail to meet applicable emission standards for their useful lives (5 years or 50,000 miles in the case of light duty vehicles); or

(b) the part or system manufacturer represents in writing that tests as described in (a) have been performed with similar results; or

(c) a federal, state, or local environmental control agency expressly represents that a reasonable basis exists.

For purposes of clauses (1), (2), and (3):

(a) the permanent removal or disconnecting or blocking of any part of the original system installed primarily for the purpose of controlling emissions will be presumed to affect adversely emission performance; and

(b) the prescription and appropriate publication by EPA of an act as prohibited will be deemed conclusive that such act will adversely affect emissions performance.

C. Discussion

1. Clause (1) will apply to replacement parts, protecting the dealer when he uses such a part to conduct necessary maintenance if a person familiar with the design and function of motor vehicles and engines would reasonably believe that such part is designed to perform the same function as the replaced part, or if there is written representation by the parts manufacturer that the part is so designed. Other reasonable bases (e.g., emissions tests showing no adverse effect) may exist, but these other bases will probably not occur often in the replacement part context. If EPA gains information that certain replacement parts do adversely affect emissions, a listing of such parts will be published.

2. Clause (2) will protect the dealer who installs add-on parts if he knows, or if it has been represented in writing to him by the part manufacturer, that emissions tests have been performed according to Federal procedures which show that such a part will not cause similar vehicles to fail to meet applicable emission standards over the useful life of the vehicle. The dealer is protected from prosecution even if the test results have not been reported to EPA. However, the aftermarket parts manufacturer who represents that such tests have been conducted should have available the data from the tests, including where, when, how and by whom the tests were conducted, should EPA request it. Such add-on parts might be auxiliary fuel tanks, which would require evaporative emission control on light duty vehicles to the prescribed standard, or superchargers, which would require emission testing showing conformance to standards over the useful life of the vehicle or engine. Clause (2) will also protect the dealer who installs retrofit devices to reduce emissions at the request of a state or local environmental control agency.

3. Clause (3) applies to dealers conducting necessary adjustments or alterations, according to the vehicle manufacturer's instructions, of parts already on the vehicle, e.g., adjustment of the carburetor or ignition timing. It also covers adjustments or alterations, as in the case of altitude "fixes", if a "reasonable basis" exists as described above.

4. This interim policy applies only to dealers, and not to motor vehicle manufacturers. Procedures exist whereby vehicle manufacturers may acquire EPA approval of any emission-related change in the vehicle from its certified configuration or parameters (See MSPC Advisory Circulars No. 2-A "Field Fixes Related to Emission Control-related Components", November 14, 1972, and No. 16 "Approval of Emission Control

Modifications for High Altitudes on New Motor Vehicles or Engines", June 8, 1972.) Hence, if a manufacturer performs or causes to be performed (e.g., by providing parts and/or instructions to dealers) any acts not approved by EPA that would constitute a change in the certified configuration or parameters of the vehicle as represented in the application for certification, including those acts addressed in the interim policy, he runs the risk of violating §203(a)(3) in the event that such act is subsequently identified as having an adverse effect on emissions performance.

5. Any questions regarding this interim policy should be addressed to the Mobile Source Enforcement Division, Office of Enforcement and General Counsel.

Norman D. Shutler

Norman D. Shutler, Director
Mobile Source Enforcement Division
Office of Enforcement and General Counsel

APPENDIX I

MANUFACTURER'S WARRANTY CORRESPONDENCE

LETTERS MAILED TO FOLLOWING ADDRESSEES

Mr. Fred Bowditch
Director of Emission Control
General Motors Technical Center
Warren, Michigan 48090

Ford Motor Company
Research and Engineering Center
20000 Rotunda Drive
Dearborn, Michigan 48121

Mr. G. A. Lacy
Vehicle Emissions Control
Engineering Research Office
Chrysler Corporation
P.O. Box 1118
Detroit, Michigan 48321

American Motors Corporation
Administrative Offices
14250 Plymouth Road
Detroit, Michigan 48232

Toyota Motor Sales, USA Inc.
2055 W. 190th Street
Torrance, California 90501

U.S. Importers, Inc.
Volkswagen of America
Englewood Cliffs, N. J.

Nissan Motors Corporation USA
18501 S. Figueroa
Gardena, California

In reply refer to
0400-73-99/RDG:ls

October 22, 1973

Olson Laboratories, Inc., is currently assisting the State of Colorado, Department of Health, in evaluating various plans to reduce and control vehicle emissions. One of these strategies involves the installation of additional exhaust control devices on a retrofit basis for 1968-1972 model year light-duty (under 6001 pounds GVW) vehicles.

Recent investigations by the Federal EPA have shown that vehicles operating at high altitude cities such as Denver emit significantly greater levels of exhaust pollutants than similar vehicles operating at lower elevations. The Colorado Health Department is currently sponsoring a test program to evaluate several devices and modifications which may reduce these excessive exhaust pollutants (see enclosure for device listing). Emission testing is being performed in accordance with Federal test procedures by a recognized, independent laboratory located in a suburb of Denver. The Denver regional office of the EPA is cognizant of this program and is providing assistance in data analysis tasks.

Assuming these devices and/or modifications are effective in reducing emission levels, the State would then implement a program to require their utilization. However, the State recognizes that vehicle owner warranties may be voided if unauthorized alterations, parts replacement, or adjustments are attempted.

It is requested that the warranty requirements of your 1968-1972 vehicles be reviewed to ascertain where problem areas may exist and notify us of such. The legality of these devices and modifications is being evaluated against the stipulations of the EPA Interim Tampering Enforcement Policy of December 22, 1972. Thank you for your assistance.

Sincerely,

Robert D. Gafford

Robert D. Gafford, Ph.D.
Vice President
Research and Engineering

Enclosure

COLORADO HEALTH DEPARTMENT
RETROFIT DEVICES TEST PROGRAM

Emission Control Approaches	Device Manufacturer
Air bleed to intake manifold	Echlin
Air bleed to intake manifold and exhaust gas recirculation	Dana Corporation
Carburetor float chamber pressure regulation	Colspan
Catalytic converter	UOP
Gaseous fuel conversion	
Carburetor modifications - changes in springs, jets, air-fuel mixture, choke setting, removal of idle screw limiter	
Ignition timing change	

TOYOTA

TOYOTA MOTOR SALES, U.S.A., INC.

CABLE ADDRESS "JIDOSHA TORRANCE"

TELEPHONES
(213) 770-1730
(213) 532-8010
TELEX 673146

2055 WEST 190TH STREET
P. O. BOX 2991
TORRANCE, CALIFORNIA 90509

November 13, 1973

TMS-WAM-3072

Mr. Robert A. Gafford
Vice President, Research & Engineering
Olson Laboratories, Inc.
421 E. Cerritos Avenue
Anaheim, California 92805

Dear Mr. Gafford:

This is in reply to your letter of October 22 regarding after market emission control devices and their effect on 1968-1972 Toyota vehicle warranty requirements.

For the most part, the majority of 1968-1972 Toyota vehicles are out of warranty. However, for 1972 vehicles still under the new car warranty, the use of a non-Toyota product, part or modification does not void the warranty. However, if the use of such a product, part or modification causes failure of other Toyota components, our warranty will not cover the replacement of those affected components.

In addition, all passenger cars from the 1972 model year are covered by a special warranty on the emission control system. This warranty provides that the car is free from defects in materials and workmanship at the time of sale, which would cause the vehicle to fail to conform with applicable Federal Environmental Protection Agency regulations for a period of five years or 50,000 miles. Due to the fact that this warranty relates only to the condition of the vehicle at the time of sale, it would not be directly affected by the addition of after market devices. However, should a situation arise presenting a question as to whether a failure to conform with applicable regulations was caused by a defect existing at the time of sale or by the addition of an after market device, the stipulations of the EPA Interim Tampering Enforcement Policy of December 1972 will have to be considered.

I hope this sufficiently answers your question on Toyota warranty requirements.

Sincerely,

Lee Sawyer
Warranty Administration Manager

LS:ak

cc: J. Parcells
R. Schrandt

GENERAL MOTORS CORPORATION

November 27, 1973

Mr. Robert D. Gafford, Ph. D.
Vice President
Research and Engineering
Olson Laboratories, Inc.
421 E. Cerritos Avenue
Anaheim, California 92805

Reference: 0400-73-99/RDG:ls

Dear Mr. Gafford:

This is in response to your letter of October 22, 1973 to Dr. Fred Bowditch, Executive Assistant to the Vice President for Vehicle Emission Matters. He has asked that the General Motors Service Section respond to your inquiry because of our responsibilities in the administration of new vehicle and emission control warranties on General Motors products.

As of this time it is our policy to consider the modifications you describe a basis for denying General Motors warranty responsibility under the express provisions of our 1972 and subsequent model year mandatory emission warranty. It is necessary to do so, first, because we are not in a position to test or otherwise determine the effect all such possible modifications would have on total vehicle emissions. Secondly, the EPA engine certification procedure is based on the original equipment emission systems and similar 50,000-mile testing programs would be required to determine the effectiveness of modifications. Finally, as you have recognized, the EPA Mobile Source Enforcement Memorandum No. 1 precludes such modification by General Motors or its dealer organization.

The General Motors New Vehicle Warranty (as distinguished from the Federal Emissions Warranty) covers only malfunctions resulting from defects in material or workmanship in the new vehicle and any equipment or accessories thereon which are manufactured or supplied by General Motors. Accordingly, products not manufactured or supplied by General Motors are not covered by the General Motors New Vehicle Warranty.

Any General Motors New Vehicle Warranty claim filed following modification of emission systems would necessarily require a determination by General Motors of whether such system adversely affected the performance and reliability of the car or any of its components. If a malfunction occurred as a result of a modification, then it follows that it was not the result of a defect in material or workmanship in an item supplied by General Motors and such malfunction would not be covered by our New Vehicle Warranty. However, defects in material and workmanship in General Motors parts not adversely affected by the non-General Motors product would be handled under the General Motors New Vehicle Warranty,

General Motors Building 3044 West Grand Boulevard Detroit, Michigan 48202

and approval of warranty claims based on the repair or replacement of such parts would not be refused simply because a product not manufactured or supplied by General Motors had been installed on the particular car.

We trust that this information will assist you in evaluating the potential applicability of certain retrofit emission devices to past model General Motors vehicles.

Very truly yours,

E. C. Henricks
Manager, Field Service Operations

ECH:ss

Ford Motor Company
Environmental and Safety
Engineering Staff

The American Road
Dearborn, Michigan 48121

December 10, 1973

Dr. Robert D. Gafford
Vice President
Research and Engineering
Olson Laboratories, Inc.
421 E. Cerritos Avenue
Anaheim, California 92805

Dear Dr. Gafford:

In reply to your letter concerning the Colorado Health Department test program to evaluate emission control devices and engine modifications on 1968-72 vehicles (Ref. 0400-73-99/RDG), the Ford Motor Company cannot at this time give you a specific answer with regard to the vehicle warranty requirements unless the specific changes on the vehicles are known.

We are definitely interested in the results of the test program and will respond promptly if you send us more details about the modifications.

Sincerely,

B. H. Simpson
Executive Engineer
Emissions Control Planning

VOLKSWAGEN OF AMERICA, INC.
ENGLEWOOD CLIFFS, N. J. 07632

December 10, 1973

Dr. Robert D. Gafford
Vice President
Olson Laboratories, Inc.
Research and Engineering
421 E. Cerritos Avenue
Anaheim, Calif. 92805

Subject: 0400-73-99/RDG:ls - Oct. 22, 1973

Dear Dr. Gafford:

The intention of Olsen Laboratories, Inc., to evaluate various plans to reduce and control vehicle emissions, particularly in the Colorado higher altitude area, is commendable.

It is our opinion that the installation of modification devices on our vehicles by your company to assist the state of Colorado, Department of Health, would not void the owner's vehicle warranty.

However, any damage or malfunction that is caused by such installation or modification will not carry the responsibility of the importer and will therefore not be covered under the VW New Vehicle Warranty.

We have enclosed copies of our 1968-1972 model warranties and hope this information will prove helpful to you.

Sincerely,

VOLKSWAGEN OF AMERICA, INC.

G. Meier
Technical Service Manager

RP:ib

enclosures

WESTERN UNION TELEX 135 427
CABLE FOLKSCAR ENGLEWOOD CLIFFS TELETYPE AREA CODE 201 567 4295 PHONES N J 201 567 7600 N Y 212 LA 4 888

No warranties, express or implied, as to Volkswagen vehicles sold in the United States are made either by Volkswagen of America, Inc. or by the manufacturer or by the selling dealer, except the following warranty by Volkswagen of America, Inc.

Warranty for new Volkswagen vehicles

This warranty is issued by Volkswagen of America, Inc. ("VWoA"), the authorized United States importer of Volkswagen vehicles.

Free repair or replacement in United States and Canada of defective parts for 24 months or 24,000 miles

1. VWoA warrants that every Volkswagen vehicle imported by VWoA and sold as a new vehicle to a retail customer by an authorized United States Volkswagen dealer will be free from defects in material and workmanship under normal use and service for 24 months after the date of delivery of the vehicle to the original retail customer or until the vehicle has been driven 24,000 miles, whichever comes first. This warranty is limited, however, to the following: If any part of the vehicle becomes defective during this period under normal use and service and the vehicle is brought to the workshop of any authorized Volkswagen dealer in the continental United States, Hawaii or Canada, the dealer will, without charge, either repair the defective part or replace it with a new or factory reconditioned part.

Maintenance and validation by owner required to keep warranty in effect

2. In order to keep this warranty in effect, the owner must do two things:
FIRST: The owner must have the vehicle maintained and serviced as prescribed in the Volkswagen Maintenance Schedule (See page 56.)
SECOND: Every twelve months during the warranty period the owner must obtain from an authorized United States Volkswagen dealer a Validation Stamp on the Maintenance Card to show that the vehicle has been maintained and serviced in accordance with the Volkswagen Maintenance Schedule. Validation will be made upon presentation of bills or other evidence sufficient to satisfy the dealer that the required service and maintenance have been performed. The validated Maintenance Card must be submitted whenever a claim is made under this warranty.

Items not covered by warranty

3. VWoA's warranty does not cover:
(i) Defects, damage or deterioration due to normal use, wear and tear or exposure; (ii) normal maintenance services, such as fuel system cleaning and wheel, brake or clutch adjustments; (iii) the replacement of service items, as, for instance, spark plugs, ignition points, V belts, wiper blades or brake and clutch linings; (iv) deterioration of upholstery, soft trim and appearance items; (v) damage or defects due to misuse, alteration, negligence or accident; and (vi) damage or defects due to the repair of the vehicle by someone other than an authorized Volkswagen dealer or the installation of parts other than genuine Volkswagen parts.

Warranty outside United States and Canada

4. If the vehicle is brought to an authorized Volkswagen workshop outside the continental United States, Hawaii or Canada, VWoA's warranty will not be applicable, and defective parts will be repaired or replaced free of charge with new or factory reconditioned parts only with the terms and limitations of the warranty for new Volkswagen vehicles in effect in the country where such authorized Volkswagen workshop is located.

No other warranties made

5. This warranty is in lieu of all other express or implied warranties of VWoA, the manufacturer and the selling dealer, including any implied warranty of merchantability or fitness for any particular purpose. Neither VWoA nor the manufacturer assumes, or authorizes any person to assume, on its behalf, any other obligation or liability.

Let us explain the warranty . . .

Volkswagen of America, Inc. is proud of the quality of automobiles it imports. It warrants new vehicles for a period of 2 years or 24,000 miles from the date of purchase, whichever comes first. In general the complete vehicle including battery and tires is covered under the provisions of the Volkswagen New Vehicle Warranty. It will be honored by any Authorized Volkswagen Dealer in all 50 States, the District of Columbia and Canada.

This warranty is transferable if the ownership of the vehicle changes within the above period.

In order to keep the warranty in force, you as the owner of the vehicle have certain responsibilities. It is important that the vehicle be maintained properly. To facilitate record keeping, this booklet provides on pages 56 to 58 space for listing maintenance services and oil changes as they are performed. **Maintenance services should be performed by Authorized Volkswagen Dealers. They offer with their factory-trained Volkswagen mechanics and special tools, fast, efficient service in accordance with Volkswagen quality standards.**

Validation is a requirement of the Volkswagen New Vehicle Warranty. One year after the date of delivery, the warranty must be validated for the second year. This can be done at any Authorized Volkswagen Dealership in the USA or Canada. For that purpose, you should present to the Authorized Volkswagen Dealer the maintenance record for your vehicle. Provided that maintenance services and oil changes were performed in accordance with Volkswagen specifications, dated bills of other than Authorized Volkswagen Dealers will be accepted as proof that these services were performed on time.

No warranties, express or implied, as to Volkswagen vehicles sold in the United States are made either by Volkswagen of America, Inc. or by the manufacturer or by the selling dealer, except the following warranty by Volkswagen of America, Inc.

Warranty for new Volkswagen vehicles

This warranty is issued by Volkswagen of America, Inc. ("VWoA"), the authorized United States importer of Volkswagen vehicles.

Free repair or replacement in United States and Canada of defective parts for 24 months or 24,000 miles

1. VWoA warrants that every Volkswagen vehicle imported by VWoA and sold as a new vehicle to a retail customer by an authorized United States Volkswagen dealer will be free from defects in material and workmanship under normal use and service for 24 months after the date of delivery of the vehicle to the original retail customer or until the vehicle has been driven 24,000 miles, whichever comes first. This warranty is limited, however, to the following: If any part of the vehicle becomes defective during this period under normal use and service and the vehicle is brought to the workshop of any authorized Volkswagen dealer in the continental United States, Hawaii or Canada, the dealer will, without charge, either repair the defective part or replace it with a new or factory reconditioned part.

Maintenance and validation by owner required to keep warranty in effect

2. In order to keep this warranty in effect, the owner must do two things:
FIRST: The owner must have the vehicle maintained and serviced as prescribed in the Volkswagen Maintenance Schedule. (See page 56.)
SECOND: Every twelve months during the warranty period the owner must obtain from an authorized United States Volkswagen dealer a Validation Stamp on the Maintenance Card to show that the vehicle has been maintained and serviced in accordance with the Volkswagen Maintenance Schedule. Validation will be made upon presentation of bills or other evidence sufficient to satisfy the dealer that the required service and maintenance have been performed. The validated Maintenance Card must be submitted whenever a claim is made under this warranty.

Items not covered by warranty

3. VWoA's warranty does not cover:
(i) Defects, damage or deterioration due to normal use, wear and tear or exposure; (ii) normal maintenance services, such as fuel system cleaning and wheel, brake or clutch adjustments; (iii) the replacement of service items, as, for instance, spark plugs, ignition points, V belts, wiper blades or brake and clutch linings; (iv) deterioration of upholstery, soft trim and appearance items; (v) damage or defects due to misuse, alteration, negligence or accident; and (vi) damage or defects due to the repair of the vehicle by someone other than an authorized Volkswagen dealer or the installation of parts other than genuine Volkswagen parts.

Warranty outside United States and Canada

4. If the vehicle is brought to an authorized Volkswagen workshop outside the continental United States, Hawaii or Canada, VWoA's warranty will not be applicable, and defective parts will be repaired or replaced free of charge with new or factory reconditioned parts only within the terms and limitations of the warranty for new Volkswagen vehicles in effect in the country where such authorized Volkswagen workshop is located.

No other warranties made

5. This warranty is in lieu of all other express or implied warranties of VWoA, the manufacturer and the selling dealer, including any implied warranty of merchantability or fitness for any particular purpose. Neither VWoA nor the manufacturer assumes, or authorizes any person to assume, on its behalf, any other obligation or liability.

Let us explain the warranty . . .

Volkswagen of America, Inc. is proud of the quality of automobiles it imports. It warrants new vehicles for a period of 2 years or 24,000 miles from the date of purchase, whichever comes first. In general the complete vehicle including battery and tires is covered under the provisions of the Volkswagen New Vehicle Warranty. It will be honored by any Authorized Volkswagen Dealer in all 50 States, the District of Columbia and Canada.

This warranty is transferable if the ownership of the vehicle changes within the above period.

In order to keep the warranty in force, you as the owner of the vehicle have certain responsibilities. It is important that the vehicle be maintained properly. To facilitate record keeping, this booklet provides on pages 58 to 61 space for listing maintenance services and oil changes as they are performed. **Maintenance services should be performed by Authorized Volkswagen Dealers. They offer with their factory-trained Volkswagen mechanics and special tools, fast, efficient service in accordance with Volkswagen quality standards.**

Validation is a requirement of the Volkswagen New Vehicle Warranty. One year after the date of delivery, the warranty must be validated for the second year. This can be done at any Authorized Volkswagen Dealership in the USA or Canada. For that purpose, you should present to the Authorized Volkswagen Dealer the maintenance record for your vehicle. Provided that maintenance services or oil changes were performed in accordance with Volkswagen specifications, dated bills of other than Authorized Volkswagen Dealers will be accepted as proof that these services were performed on time.

No express warranties, as to Volkswagen vehicles sold in the United States are made either by Volkswagen of America, Inc. ("VWoA"), or by the manufacturer, the distributor or the selling dealer, except the following warranty by Volkswagen of America. Inc.

Warranty for New Volkswagen Vehicles

This warranty is issued by Volkswagen of America, Inc. ("VWoA"), the authorized United States importer of Volkswagen vehicles.

Free repair or replacement in the United States and Canada of defective parts for 24 months or 24,00 miles

1. VWoA warrants that every Volkswagen vehicle imported by VWoA and sold as a new vehicle to a retail customer by an authorized United States Volkswagen dealer will be free from defects in material and workmanship under normal use and service for 24 months after the date of delivery of the vehicle to the the original retail customer or until the vehicle has been driven 24.000 miles, whichever comes first. This warranty is limited, however, to the following. If any part of the vehicle becomes defective under normal use and service and the vehicle is brought during this period to the workshop of any authorized Volkswagen dealer in the continental United States, Hawaii or Canada, the dealer will without charge, either repair the defective part or replace it with a new or factory reconditioned part.

Maintenance required to keep warranty in effect

2. In order to keep this warranty in effect, the owner must have the vehicle maintained and serviced as prescribed in the Volkswagen Maintenance Schedule.

Items not covered by warranty

3. VWoA's warranty does not cover:
(i) Defects, damage or deterioration due to normal use, wear and tear or exposure; (ii) normal maintenance services, such as fuel system cleaning and wheel, brake or clutch adjustments; (iii) the replacement of service items, as, for instance, spark plugs, ignition points, wiper blades or brake linings; (iv) deterioration of upholstery, soft trim and appearance items; (v) damage or defects due to misuse, alteration, negligence or accident; (vi) damage or defects due to the repair of the vehicle by someone other than an authorized Volkswagen dealer or the installation of parts other than genuine Volkswagen parts; (vii) damage or defects due to the use of the vehicle in competitive events, including rallies and races; (viii) and loss of time, inconvenience, loss of use of the vehicle or other consequential damage.

Warranty outside the United States and Canada

4. If the vehicle is brought to an authorized Volkswagen workshop outside the continental United States, Hawaii or Canada, VWoA's warranty will not be applicable and defective parts will be repaired or replaced free of charge with new or factory reconditioned parts only within the terms and limitations of the warranty for new Volkswagen vehicles in effect in the country where such authorized Volkswagen workshop is located.

No other warranties made

5. This warranty is in lieu of all other express warranties of VWoA, the manufacturer, the distributor and the selling dealer. Neither VWoA nor the manufacturer assumes, or authorizes any person to assume, on its behalf, any other obligation or liability.

Let us explain the warranty ...

Volkswagen of America, Inc. is proud of the quality of the automobiles it imports. It warrants new vehicles for a period of 2 years or 24,000 miles from the date of purchase, whichever comes first. In general, the complete vehicle including battery and tires is covered under the provisions of the Volkswagen New Vehicle Warranty. It will be honored by any Authorized Volkswagen Dealer in all 50 States, the District of Columbia and Canada.

This warranty is transferable if the ownership of the vehicle changes within the above period.

In order to keep the warranty in force, you, as the owner of the vehicle, have certain responsibilities. It is important that the vehicle be maintained properly. To facilitate record keeping this booklet provides space for listing diagnosis, maintenance and oil change services as they are performed.

Diagnosis and maintenance services should be performed by Authorized Volkswagen dealers. They have Volkswagen trained mechanics and special tools to provide fast, efficient service in accordance with Volkswagen quality standards.

The terms of your warranty require you to keep a maintenance record of your vehicle. Provided that maintenance or oil change services were performed in accordance with Volkswagen specifications, dated bills of other than Authorized Volkswagen dealers will be accepted as proof that these services were performed when required.

Except for the following warranty and the Emission Control System warranty by Volkswagen of America, Inc. no express warranties as to Volkswagen vehicles sold in the United States are made either by Volkswagen of America, Inc. ("VWoA"), or by the manufacturer, the distributor or the selling dealer.

Warranty for New Volkswagen Vehicles

This warranty is issued by Volkswagen of America, Inc. ("VWoA"), the authorized United States importer of Volkswagen vehicles.

Free repair or replacement in the United States and Canada of defective parts for 24 months or 24,000 miles

1. VWoA warrants that every Volkswagen vehicle imported by VWoA and sold as a new vehicle to a retail customer by an authorized United States Volkswagen dealer will be free from defects in material and workmanship under normal use and service for 24 months after the date of delivery of the vehicle to the original retail customer or until the vehicle has been driven 24,000 miles, whichever comes first. This warranty is limited, however, to the following: if any part of the vehicle becomes defective under normal use and service and the vehicle is brought during this period to the workshop of any authorized Volkswagen dealer in the continental United States, Hawaii or Canada, the dealer will without charge either repair the defective part or replace it with a new or factory reconditioned part.

Maintenance required to keep warranty in effect

2. In order to keep this warranty in effect, the owner must have the vehicle maintained and serviced as prescribed in the Volkswagen Maintenance Schedule.

Items not covered by warranty

3. VWoA's warranty does not cover: (i) Defects, damage or deterioration due to normal use, wear and tear or exposure; (ii) normal maintenance services, such as fuel system cleaning and wheel, brake or clutch adjustments; (iii) the replacement of service items, as for instance, spark plugs, ignition points, wiper blades or brake linings; (iv) deterioration of upholstery, soft trim and appearance items; (v) damage or defects due to misuse, alteration, negligence or accident; (vi) damage or defects due to the repair of the vehicle by someone other than an authorized Volkswagen dealer or the installation of parts other than genuine Volkswagen parts; (vii) damage or defects due to the use of the vehicle in competitive events, including rallies and races; and (viii) loss of time, inconvenience, loss of use of the vehicle or other consequential damage.

Warranty outside the United States and Canada

4. If the vehicle is brought to an authorized Volkswagen workshop outside the continental United States, Hawaii or Canada, VWoA's warranty will not be applicable and defective parts will be repaired or replaced free of charge with new or factory reconditioned parts only within the terms and limitations of the warranty for new Volkswagen vehicles in effect in the country where such authorized Volkswagen workshop is located.

No other warranties made

5. This warranty and the Emission Control System warranty for Volkswagen vehicles are in lieu of all other express warranties of VWoA, the manufacturer, the distributor and the selling dealer. Neither VWoA nor the manufacturer assumes, or authorizes any person to assume, on its behalf, any other obligation or liability.

Warranty for New Volkswagen Vehicles

This warranty is issued by Volkswagen of America, Inc. ("VWoA"), the authorized United States importer of Volkswagen vehicles.

Free repair or replacement in the United States and Canada of defective parts for 12 months or 20,000 miles

1. VWoA warrants that every 1974 Volkswagen vehicle imported by VWoA and sold as a new vehicle to a retail customer will be free from defects in material and workmanship for 12 months after the date of delivery of the vehicle to the original retail customer or until the vehicle has been driven 20,000 miles, whichever comes first. This warranty is limited, however, to the following. If the vehicle becomes defective under normal use and service and is brought during this period to the workshop of any authorized Volkswagen dealer in the continental United States, Hawaii or Canada, the dealer will, without charge, repair any defective part or replace it with a new or factory reconditioned part.

Maintenance required to keep warranty in effect

2. In order to keep this warranty in effect, the owner must have the vehicle maintained and serviced as prescribed in the Volkswagen Maintenance Schedule.

Items not covered by warranty

3. VWoA is not responsible for: (i) damage or malfunctions resulting from: (a) accident, misuse, negligence or alteration; (b) improper repair of the vehicle, (c) use of the vehicle in competitive events; or (d) failure to follow recommended maintenance requirements: and (ii) loss of time, inconvenience, loss of use of the vehicle or other consequential damage. Maintenance services, and the replacement of service items, such as air and fuel filters, and lubricants and fluids are also at the expense of the owner.

Warranty outside the United States and Canada

4. If the vehicle is brought to an authorized Volkswagen workshop outside the continental United States, Hawaii or Canada, VWoA's warranty will not be applicable and defective parts will be repaired or replaced free of charge with new or factory reconditioned parts only within the terms and limitations of the warranty for new Volkswagen vehicles in effect in the country where such authorized Volkswagen workshop is located.

No other warranties made

5. This warranty and the emission control system warranty for Volkswagen vehicles are in lieu of all other express warranties of VWoA, the manufacturer, the distributor and the selling dealer. Neither VWoA nor the manufacturer assumes, or authorizes any person to assume, on its behalf, any other obligation or liability.

APPENDIX J

IDLE TEST PROCEDURES
FOR
PARTICIPATING GARAGES

IDLE TEST PROCEDURES FOR PARTICIPATING GARAGES

Prepared for

The Air Pollution Control Division
Department of Health
State of Colorado

Prepared by

OLSON LABORATORIES, INC.
A Subsidiary of Northrop Corporation

1.0 SPARK IGNITION-POWERED MOTOR VEHICLE EMISSION LIMITS

Table 1 shows the exhaust emission limits for spark ignition-powered motor vehicles when measured by an approved exhaust gas analytical system using the appropriate test procedures.

Table 1

EMISSION STANDARDS FOR SI MOTOR VEHICLES
AT 50% REJECTION RATE

Vehicle Model Year	HC	CO
1968 and newer	300 ppm	3.0%
Pre-1968	600 ppm	4.5%

2.0 EMISSIONS-ORIENTED MAINTENANCE OF SPARK IGNITION VEHICLES

Inspected vehicles failing to comply with the emission standards described in paragraph 1.0 shall be serviced and repaired prior to reporting for reinspection. The following paragraphs identify the recommended procedures and instrumentation for servicing and repairing vehicles that fail to meet the emission limitations. Other procedures, techniques, or instrumentation that achieve the desired emission reduction are acceptable and encouraged. However, no person shall disconnect, modify, remove, or otherwise alter any motor vehicle emission control device or system installed in compliance with Federal, State, County, or City standards, regulations, and ordinance, unless such action will result in continuing compliance with the applicable emission requirements.

2.1 Instrumentation

Table 2 lists the recommended equipment required to perform emission-oriented service and repair.

Table 2

RECOMMENDED EQUIPMENT

Type
HC and CO Analyzer
Ignition Analyzer, Oscilloscope
Ignition Timing Light
Tachometer
Distributor Advance Tester
Voltmeter, Ammeter, Ohmmeter
Vacuum Gauge, Pressure Gauge
Compression Tester
Dwell Meter

2.2 Service and Repair Procedure

2.2.1 Pre-Test

Prepare vehicle and equipment for test.

Test Equipment - Service, warm-up, and calibrate HC/CO test equipment per manufacturer's specifications.

Test Vehicle - Verify engine is at normal operating temperature (warm-up as required).

Hook-up - Insert probe in exhaust pipe (driver side if dual exhaust), hook-up tachometer per manufacturer's instructions.

2.2.2 Test

Perform HC/CO and rpm measurements and compare to Idle Test Standards.

2500 rpm - Operate engine in neutral at 2500 rpm; record HC/CO.

Idle rpm - Operate engine at idle rpm (in drive if automatic transmission); record measurements.

Compare - Idle rpm emissions to test standards and record manufacturer's specified rpm; if HC or CO is high, adjust per paragraph 2.2.3.

2.2.3 Adjust

Perform engine adjustments for HC/CO. When any adjustment step brings emissions within limits, STOP procedure at that point and re-test per paragraph 2.2.2.

Rpm - Adjust (if required) to manufacturer's specifications; recheck HC and CO and record.

HC - Check timing per manufacturer's procedure, and record. If timing is not as manufacturer's specification, adjust as required; re-adjust rpm, if required; re-check HC/CO and record.

CO - Adjust idle mixture to manufacturer's specification. Where no specifications are available, use 2.0% to 4.0% for pre-1968 vehicles and 1.0% to 3.0% for post-1967 vehicles. Re-adjust rpm, if required.

After adjustment, enrich mixture slightly to avoid too lean a condition. Recheck HC/CO, and record.

When adjusting idle CO, attempt to reduce CO to lowest possible value consistent with good idle quality. Avoid a rough idle condition, side-to-side unbalance or increase in HC (HC increase indicates a lean idle misfire).

If CO/HC emissions cannot be reduced to within limits while maintaining acceptable idle quality, diagnose and repair vehicle as required. ONLY those repairs necessary to bring idle HC/CO within limits are to be accomplished.

2.2.4 Repair

Table 3 shows some probable causes for vehicles failing to comply with the emission standards. The table should be used as an aid in diagnosing the cause for failure. The general steps recommended are:

Evaluate test results - as provided by vehicle inspection station to owner.

Consult information sources - probable causes and malfunction table, owner's vehicle manual, manufacturer's manual, automotive shop service manual.

Perform failure diagnostic - as determined from above information sources and test results, and using test equipment as necessary.

Repair malfunction - remove and replace defective components; adjust as required.

Retest - as per paragraph 2.2.2.

2.3 Maintenance Record

A maintenance record documenting the parts replaced and the engine parameters adjusted, such as injector plunger adjustment, rack adjustment, and fuel distributor timing, will be required for each vehicle repaired and/or serviced.

Table 3

PROBABLE CAUSES FOR HIGH EMISSIONS*

Probable Causes	HC		CO		Rough Idle
	High	Very High	High	Very High	
PCV Valve Dirty/ Restricted			X		X
Air Cleaner Dirty/ Restricted			X	X	
Choke Stuck Partially Closed				X	
Carburetor Idle Circuit Malfunction	X		X		X
Intake Manifold Leak	X	X			X
Ignition Timing Advanced	X				
Leaky Exhaust Valves	X	X			X
Ignition System Misfire	X	X			X

***HELPFUL HINTS**

High HC - May be caused by ignition misfires, advanced ignition timing, exhaust valve leakage, and over-lean mixtures. Ignition misfires can be diagnosed by use of the oscilloscope, timing problems by use of the timing light. Valve failure may be detected by cylinder balance testing with compression test verification. Lean misfire may be caused by too lean idle mixture setting or manifold vacuum leaks.

High CO - May be caused by abnormally restricted air cleaner, stuck or partially closed choke, or carburetor idle circuit failure. Rough or erratic idle may be caused by PCV valve malfunction. Idle HC/CO failure/malfunction Truth Table may be used as a guide to identifying failures.

APPENDIX K

EXAMPLES OF INSPECTION DATA FORMS

MAKE	YR	BODY	SERIAL NUMBER	MODEL	DATE	SN	TITLE NUMBER	MILEAGE	TAG NUMBER	TV	[illegible]
HD	48	MC	48F13301		71/08/19	2	F456207		M001		

ACCIDENT OR RECALL STATUS	CASE NUMBER	STICKER NUMBER
RECALLS-000 ACCIDENTS-000		

ITEMS INSPECTED				NO.	OK
[illegible] Card A [illegible] B Mark[illegible]	A	B		1	
A [illegible] B [illegible]	A	B		2	
[illegible] A [illegible] B Controls	A	B		3	
A [illegible] B [illegible] C [illegible]	A	B	C	4	
A [illegible] B Bumpers	A	B		5	
Reflectors A Side B Rear	A	B		6	
Lights A S[illegible] B Backups C [illegible] D Stop E Tag F Clearance G [illegible] H Fog	A	B	C	7	
	D	E	F		
	G	H			
[illegible] A [illegible] B Indicators C Appearance D [illegible] E Glass	A	B	C	8	
	D	E			
Steering A [illegible] B [illegible] C [illegible] Cont. Arm [illegible] Shackles [illegible] [illegible] K [illegible] L Power Steering	A	B	C	9	
	D	E	F		
	G	H	I		
	J	K	L		
A [illegible] Shocks C [illegible]	A	B	C	10	
Tires [illegible]	A	B		11	
[illegible]	A	B	C	12	
[illegible] Heaters	A	B	C	13	
A [illegible] Washers [illegible]meters	A	B		14	
[illegible]	A	B		15	
	C	D			
[illegible] A M Cyl B Hoses C Pedal [illegible] D Disc E [illegible] F Dual Sys G Ped Pres	A	B	C	16	
	D	E	F		
	G				
Accessory Brake				17	
Misc				18	

For TAXI ONLY

Identification Color	A	
Trade Name and Insignia	B	
Rate signs and Zone Map	C	
Upholstery	D	
Sanitation	E	
Cruising Light	F	

5	4	3	2					
					1	2	3	4
			5	6	7	8	9	10	11
			12	13	14	15	16	17	18

OFFICE COPY

VEHICLE INFORMATION

MAKE	YR	BODY	SERIAL NUMBER	MODEL	DATE	SN	TITLE NUMBER	MILEAGE	TAG NUMBER	TV	[illegible]
HD	48	MC	48F13301		71/08/19	2	F455297		M001		

ACCIDENT INFORMATION

CASE NO. 1	DAMAGE	COST	REPAIR
			ABC
CASE NO. 2	DAMAGE	COST	REPAIR
			ABC
CASE NO. 3	DAMAGE	COST	REPAIR
			ABC

EXHAUST EMISSION DATA

IDLE	
HC	CO
AVG.	
HC	CO
HIGH	
HC	CO

RECALL CAMPAIGNS

CAMPAIGN 1	LETTER CODE	DLR REPAIR	ST INSP	[illegible]
	ABC	ABCD	ABC	ABCD
CAMPAIGN 2	LETTER CODE	DLR REPAIR	ST INSP	COLLECTION
	ABC	ABCD	ABC	ABCD
CAMPAIGN 3	LETTER CODE	DLR REPAIR	ST INSP	[illegible]
	ABC	ABCD	ABC	ABCD

*

DMV 51-10 (Revised Jan. 71)

OFFICIAL INSPECTION RECORD-DEPARTMENT OF MOTOR VEHICLES, D.C.

PLEASE KEEP THIS CARD FLAT AND CLEAN AND WITH CAR. It must be presented with your vehicle for re-inspection. Loss of card may cause delay in inspection procedure.

Issuance of this card indicates that the vehicle described hereon has been rejected. The items causing rejection are indicated by punch mark opposite the items rejected.

Vehicles rejected are issued a red rejection sticker upon which is stamped a definite date, and on or before that date the vehicle shall be returned for final approval. Additional time for re-inspection cannot be granted.

Necessary adjustments, corrections or repairs may be made by any person of your choice, and at any place. Inspection station personnel will do NO work pertaining to adjustments, corrections or repairs, nor indicate how or where such work should be done.

IN	IN	IN	IN	IN	IN
1	2	3	4	5	6

ITEMS INSPECTED				REJ	OK
Registration Card A(Inst.)-B(Mutil.)	A	B		1	
A(Serial No.) B(Tags)	A	B		2	
Glass A(Cracked)-B(Controls)	A	B		3	
A(Doors)-B(Body) C(Hood)	A	B	C	4	
A(Fenders) B(Bumpers)	A	B		5	
Reflectors A(Sides)-B(Rear)	A	B		6	
[illegible] A([illegible])-B(Backup) C([illegible]) D(Stop) E([illegible]) F(Clearance) G(Marker)-H(Fog)	A	B	C	7	
	D	E	F		
	G	H			
Headlamps A([illegible])-B(Indicator) C(A[illegible]) D(Intensity)-E(Out)	A	B	C	8	
	D	E			
Steering A(Kingpins)-B(Shocks) C(Ball Joints)-D(Cont. Arm) E(Springs)-F(Shackles) G(Gear)-H(Bearings) I(Linkage)-J(Column) K(Alignment) L(Power Steering)	A	B	C	9	
	D	E	F		
	G	H	I		
	J	K	L		
A(Exhaust)-B(Smoke) C(PCV Valve)	A	B	C	10	
Tires A(Tread)-B(Cut)	A	B		11	
A(Mirrors)-B(Horn) C(Seat Belts)	A	B	C	12	
A(W S Glare) B(Wipers)-C(Blades)	A	B	C	13	
A(W S Washer) ● B(Speedometer)	A	B		14	
Brakes Equalization A(Lt.)-B(Rt.) C(Lt.)-D(RR)	A	B		15	
	C	D			
Mechanism A(M Cyl.)-B(Hose) C(Pedal Res.)-D(Disc) E(Drums)-F(Dual Sys.) G(Pad Pedal)	A	B	C	16	
	D	E	F		
	G				
Auxiliary Brake				17	
Misc.				18	
For TAXI ONLY: Identification Color				A	
Trade Name and Insignia				B	
Rate signs and Zone Map				C	
Upholstery				D	
Sanitation				E	
Cruising Light				F	

			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	[illegible]

Manitoba

ONTARIO DEPARTMENT OF TRANSPORT

VEHICLE BRANCH

ONTARIO

MOTOR VEHICLE INSPECTION REPORT

NOTE:- THIS IS NOT A CERTIFICATE OF MECHANICAL FITNESS AS REQUIRED BY SECTION 49-1 H.T.A. AND ONTARIO REGULATION 354/63

REGISTERED OWNER ADDRESS

NO. 65026

DATE

TIME A.M. P.M.

RECHECK ☐ 1. ☐ 2. ☐ 3. ☐ 4.

☐ VOLUNTARY ☐ ATTENTION RECOMMENDED

☐ COMPULSORY ☐ PLATES REMOVED

VEHICLE IDENTIFICATION

MAKE

PLATE NO.

SERIAL NO.

TYPE

YEAR

MILEAGE

NOTE:- THE FOLLOWING COMPONENTS OF THIS MOTOR VEHICLE HAVE BEEN INSPECTED TO CHECK COMPLIANCE WITH EQUIPMENT REQUIREMENTS AND MINIMUM PERFORMANCE STANDARDS.
AN (X) MARK INDICATES ITEM NOT IN COMPLIANCE OR ATTENTION RECOMMENDED.
AN (XX) MARK INDICATES ITEMS IN HAZARDOUS CONDITION.

INSPECTORS INITIALS

1) BODY EXTERIOR:-

☐ GLASS CONDITION
☐ WINDSHIELD WIPERS
☐ VISIBILITY OBSTRUCTION
☐ TAIL LAMPS
☐ BRAKE LAMPS
☐ CLEARANCE LAMPS
☐ DOORS
☐ DIRECTION LAMPS
☐ PARKING LAMPS
☐ NUMBER PLATE LAMP
☐ OTHER LAMPS
☐ IDENTIFICATION LAMP
☐ BUMPERS
☐ HORN
☐ BODY CONDITION
☐ FILLER CAP
☐ FENDERS
☐ MUD FLAPS

1)

2) STEERING AND SUSPENSION:-

☐ ALIGNMENT TOE - IN
☐ ALIGNMENT TOE - OUT
☐ KING PINS
☐ STEERING LASH
☐ STEERING TRAVERSE
☐ BALL JOINTS
☐ DRAG LINK
☐ IDLER ARM
☐ RIGHT SUSPENSION
☐ LEFT SUSPENSION
☐ TIE-ROD ENDS
☐ SHOCK ABSORBERS
☐ WHEEL BEARING PLAY
☐ SPRINGS
☐ STEERING ARM
☐ STEERING BOX
☐ STEERING PLAY
☐ WHEELS
☐ STEERING SHAFT
☐

2)

3) TIRES, EXHAUST AND UNDERBODY COMPONENTS:-

TIRES
☐ L.F.
☐ L.R.
☐ R.F.
☐ R.R.
☐ CHASSIS FRAME
☐ FLOOR PAN
☐ REAR AXLE TRACKING
☐ EXHAUST SYSTEM
☐ FRONT BRAKE FLEX LINES
☐

3)

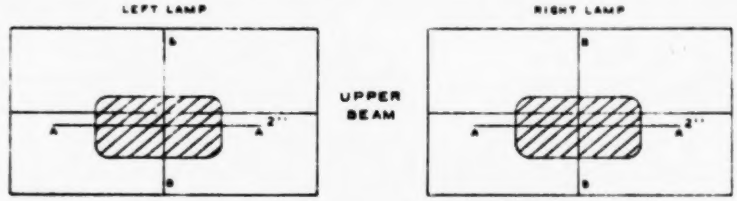
4) ENGINE COMPARTMENT:-

☐ ACCELERATOR LINKAGE SYSTEM
☐ FRONT FUEL FLEX LINES
☐ POWER STEERING DRIVER BELT
☐ CARBURETOR OR INJECTION PUMP CONTROLS & LINKS
☐ RESERVOIR LEVELS
☐ HOOD LATCH
☐ HORN MOUNTING
☐ STEERING BOX FOR SECURITY

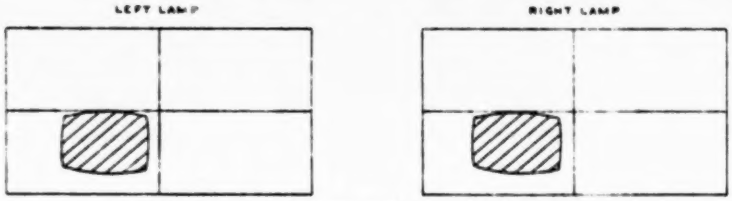
4)

5) HEADLAMP AIM:-

AS IT APPEARS ON TESTER SCREEN WITH INSPECTOR FACING VEHICLE



CENTRE OF HOTSPOT MUST FALL WITHIN SHADED AREA



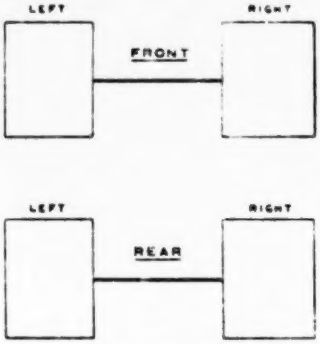
UPPER RIGHT EDGE OF HOTSPOT MUST FALL WITHIN SHADED AREA

☐ HEADLAMP SHUTTER IF EQUIPPED
☐ OTHER DEFECTS

5)

6) BRAKES:-

☐ BRAKE FLUID LEAKAGE
☐ PEDAL RESERVE
☐ PARKING BRAKE MECHANISM
☐ BRAKING FORCE
☐ BRAKING FORCE DISTRIBUTION
☐ BRAKE PEDAL PAD



6)

7) BODY INTERIOR:-

☐ UPPER BEAM INDICATOR LAMP
☐ TURN SIGNAL INDICATOR LAMP
☐ SEATS
☐ DEFROSTER
☐ STEERING COLUMN
REARVIEW MIRRORS ☐ INSIDE ☐ OUTSIDE

7)

REMARKS:-

K-4

LOCATION:-

VEHICLE INSPECTION REPORT

The vehicle described here has been inspected by the New York City Taxi and Limousine Commission Inspection Facility. The RESULTS of that inspection are shown in the results column. Information regarding correction of deficient items is listed on the attached sheet. It is the responsibility of the vehicle owner to see that these REPAIR INSTRUCTIONS are obtained and complied with.

Michael J. Lazar
Chairman

○	○	○	○	○	○
GM	FRD	CHR	AM	CHE	OTHER

IDENTIFICATION NO.

LANE

76
75
74
73
72
71
70
ORDER
LANE 1
LANE 2

FUNCTION	DEFICIENT ITEM	RESULTS P	C	S	F
STATION 0					
1. DOCUMENTATION	[illegible]	☐	☐	☐	
2. HORN	HORN	☐	☐	☐	
STATION 1					
3. WHEEL ALIGNMENT	WHL ALN	☐	☐	☐	
4. WASHERS/WIPERS	WASHER WIPER	☐	☐	☐	
5. HEADLIGHTS	AIM INTEN FOCUS	☐	☐	☐	
6. RUNNING LIGHTS	[illegible] IN SVC B UP LIC PLT	☐	☐	☐	
7. SIGNAL LIGHTS	BRAKE TURN EMERG	☐	☐	☐	
8. EXTERIOR CONDITION	BUMPER [illegible] [illegible] [illegible] GLAZING MIRROR	☐	☐	☐	
9. TIRES/WHEELS	[illegible]	☐	☐	☐	☐
10. UNDERHOOD	[illegible] PCV RAD OIL GAS BR FLU LEAKAGE LATCH	☐	☐	☐	☐
STATION 2					
11. BRAKES	☐ ☐	☐	☐	☐	☐
12. EMISSIONS	HC CO	☐	☐	☐	☐
13. SPEEDO MILEAGE	ACCUR	☐	☐	☐	
14. TAXIMETER	ACCUR	☐	☐	☐	☐
STATION 3					
15. INTERIOR/COMFORT	[illegible] HEAT A/C [illegible]	☐	☐	☐	
16. STEERING	LATCH PLAY [illegible]	☐	☐	☐	☐
17. SUSPENSION	[illegible]	☐	☐	☐	☐
18. UNDERCARRIAGE	[illegible]	☐	☐	☐	☐
TIRE CONDITION	[illegible]	REPORT IN 9 ABOVE			

1 C S F
2 C S F
3 C S F
4 C S F
5 C S F
6 C S F
7 C S F
8 C S F
9 C S F
10 C S F
11 C S F
12 C S F
13 C S F
14 C S F
15 C S F
16 C S F
17 C S F
18 C S F
19 C S F

ONTARIO DEPARTMENT OF TRANSPORT

Mantoba
ONTARIO

VEHICLE BRANCH

MOTOR VEHICLE INSPECTION REPORT

NOTE:- THIS IS NOT A CERTIFICATE OF MECHANICAL FITNESS AS REQUIRED BY SECTION 49-1 H.T.A. AND ONTARIO REGULATION 354/68

REGISTERED OWNER ADDRESS

NO. 65026

DATE

TIME A.M. P.M.

RECHECK ☐1. ☐2. ☐3. ☐4.

☐ VOLUNTARY
☐ COMPULSORY
☐ ATTENTION RECOMMENDED
☐ PLATES REMOVED

VEHICLE IDENTIFICATION

MAKE

PLATE NO.

SERIAL NO.

TYPE

YEAR

MILEAGE

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AN (XX) MARK INDICATES ITEMS IN HAZARDOUS CONDITION.

INSPECTORS INITIALS

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☐ WINDSHIELD WIPERS
☐ VISIBILITY OBSTRUCTION
☐ TAIL LAMPS
☐ BRAKE LAMPS
☐ CLEARANCE LAMPS
☐ DOORS
☐ DIRECTION LAMPS
☐ PARKING LAMPS
☐ NUMBER PLATE LAMP
☐ OTHER LAMPS
☐ IDENTIFICATION LAMP
☐ BUMPERS
☐ HORN
☐ BODY CONDITION
☐ FILLER CAP
☐ FENDERS
☐ MUD FLAPS

1)

2) STEERING AND SUSPENSION:-

☐ ALIGNMENT TOE – IN
☐ ALIGNMENT TOE – OUT
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☐ IDLER ARM
☐ RIGHT SUSPENSION
☐ LEFT SUSPENSION
☐ TIE-ROD ENDS
☐ SHOCK ABSORBERS
☐ WHEEL BEARING PLAY
☐ SPRINGS
☐ STEERING ARM
☐ STEERING BOX
☐ STEERING PLAY
☐ WHEELS
☐ STEERING SHAFT
☐

2)

3) TIRES, EXHAUST AND UNDERBODY COMPONENTS:-

TIRES
☐ L.F.
☐ L.R.
☐ R.F.
☐ R.R.
☐ CHASSIS FRAME
☐ FLOOR PAN
☐ REAR AXLE TRACKING
☐ EXHAUST SYSTEM
☐ FRONT BRAKE FLEX LINES
☐

3)

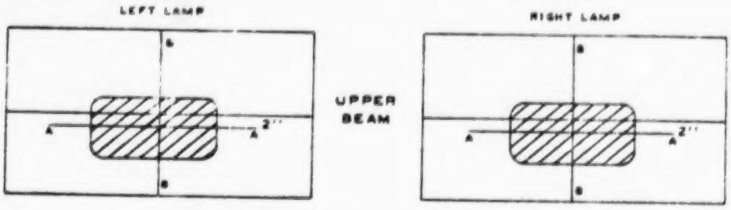
4) ENGINE COMPARTMENT:-

☐ ACCELERATOR LINKAGE SYSTEM
☐ FRONT FUEL FLEX LINES
☐ POWER STEERING DRIVER BELT
☐ CARBURETOR OR INJECTION PUMP CONTROLS & LINKS
☐ RESERVOIR LEVELS
☐ HOOD LATCH
☐ HORN MOUNTING
☐ STEERING BOX FOR SECURITY

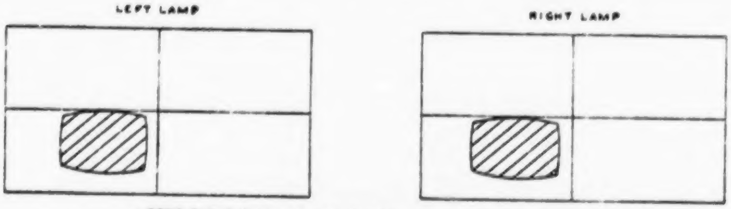
4)

5) HEADLAMP AIM:-

AS IT APPEARS ON TESTER SCREEN WITH INSPECTOR FACING VEHICLE



CENTRE OF HOTSPOT MUST FALL WITHIN SHADED AREA

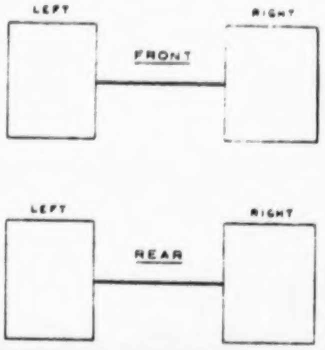


UPPER RIGHT EDGE OF HOTSPOT MUST FALL WITHIN SHADED AREA

☐ HEADLAMP SHUTTER IF EQUIPPED
☐ OTHER DEFECTS

6) BRAKES:-

☐ BRAKE FLUID LEAKAGE
☐ PEDAL RESERVE
☐ PARKING BRAKE MECHANISM
☐ BRAKING FORCE
☐ BRAKING FORCE DISTRIBUTION
☐ BRAKE PEDAL PAD



5)

6)

7) BODY INTERIOR:-

☐ UPPER BEAM INDICATOR LAMP
☐ TURN SIGNAL INDICATOR LAMP
☐ SEATS
☐ DEFROSTER
☐ STEERING COLUMN
REARVIEW MIRRORS ☐ INSIDE ☐ OUTSIDE

7)

REMARKS:-

K-4

LOCATION:-